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MODERN PLASTICS

DECEMBER 1946

CAST PLASTIC DIES · PATTERNS · JIGS

Typical of the current trend toward making production methods ultra-efficient is the use of Durez casting resin . . . to reduce the time and cost involved in conventional die-, pattern-, and jig-making . . . to speed production.

Cast Plastic Dies

Durez casting resin lends itself readily to cast forms for hydropress operation. The cast plastic die illustrated above left is used regularly under 75 tons press load and has produced hundreds of pieces, similar to the one shown below it, without flaw. Tests have shown it to be capable of withstanding up to 270 tons press load, equivalent to about 12,000 psi.

Cast Plastic Patterns

Alert foundrymen everywhere have been quick to see the production advantages of cast Durez resin patterns such as the match plate illustrated above center. The inexpensive Durez casting resin is simply poured and cured. The perfectly reproduced pattern is then mounted on the plate. The time- and cost-saving benefits are obvious.

Cast Plastic Jigs

The fixture, illustrated above right, for holding die-cast metal covers while a few finishing operations are performed is an excellent example of the simplicity of producing such fixtures with Durez casting resin. It was only necessary to coat the inside of one of the covers with a parting agent and pour in the resin. While the resin was in a semi-viscous state, the stud was located in place. After allowing the assembly to set for a few hours, it was placed in an oven and cured. When taken from the oven, the die-cast cover was removed and the fixture ready for use, the stud being anchored securely in the resin. Long-wearing qualities of the casting resin are excellent.

Characteristics of Casting Resin

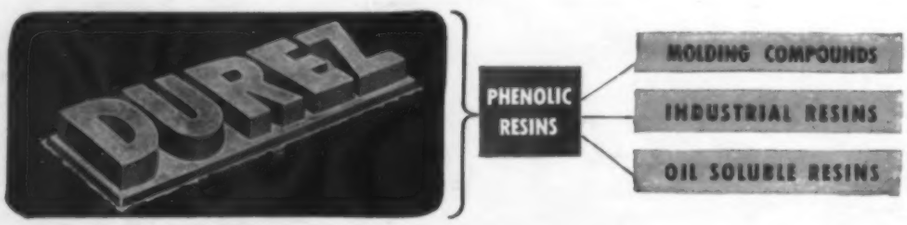
Tests have shown that Durez casting resin may be sawed easily, that it drills like hard maple wood, that it will not hold heat or be softened by it, and that it will not ignite. Standard wood- or metal-working equipment may be used. The liquid resin follows the contours of any part exactly and holds them to predetermined tolerances. Its shrinkage factor is but .0025 inches per inch.

Other Uses

A few additional uses for Durez casting resin are stretch-press dies, masking shields for plating, models for testing and duplicating, and checking and assembly fixtures.

Informative Booklet

As specialists in the production of phenolic plastics and resins for almost three decades, Durez technicians have gained an enviable record for developing plastics and resins that fit the job. This background includes molding compounds, industrial and protective coating resins. The benefits which this rich experience can provide are available to you. Write for complete, authoritative folder on casting resin. Durez Plastics & Chemicals, Inc., 512 Walck Road, North Tonawanda, N. Y.



PLASTICS THAT FIT THE JOB

Among Time-honored Manufacturers *Catalin* is the Plastics of their Choice!

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As producer of the gem-like cast phenolics, polystyrene injection molding compounds, phenolic compression molding compounds and a host of thermoplastic and thermosetting liquid resins, we welcome the opportunity to sit in with product designers, engineers or manufacturers and their appointed fabricators or molders, at a time when creative pencils are busy. The selection of the right material, combined with advance discussions as to proper processing methods and mold or arbor design, can gain much from a before-hand meeting of minds. Inquiries are invited!

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

CAST RESINS • LIQUID RESINS • MOLDING COMPOUNDS

MODERN PLASTICS

VOLUME 24 DECEMBER 1946 NUMBER 4

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Traffic paint protectors designed, patented and manufactured by Plastic Engineering, Inc.

Now they're making highway markers from GEON

Another interesting application for GEON raw materials

THOSE highway markers—more properly known as "traffic paint protectors"—are lightweight, easy to handle. They're permanently colored, unaffected by sun, rain, air, heat, cold, paint, oil, or any one of hundreds of normally destructive factors. They're sufficiently resilient that they won't break when dropped from truck to painted line. Nor will they harm a tire if accidentally struck by a car. It was possible to mold them from one of the GEON polyvinyl materials in such a way that they stack easily, yet always land in the right position when dropped from the paint truck.

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And GEON can be pressure or injection molded, extruded, calendered or cast into sheet or film. In solution or latex forms it can be applied as coatings for fabrics and fibres of all kinds as well as for paper and cardboard. Products made from GEON may be flexible or rigid, clear or opaque, brilliantly or delicately colored.

For more information about GEON, please write Dept. I-12, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

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Molding *special* plastics parts for industry is our business . . . the only business we have.

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In our modern three-acre plant you will find scores of compression molding presses in every needed size and type . . . a separate building devoted entirely to thermoplastics, with modern injection presses in a complete range of sizes for every job. Here, too, you will find one of the largest and best equipped mold-making departments in the industry. And coupled with all this is the experience of over a quarter century in plastics.

These factors are all important. Perhaps that's why so many leaders of industry specify CMPC as their principal source of supply for molded plastics . . . why you'll find it profitable to do likewise. For immediate action, consult with a CMPC Service Engineer. There's no obligation.

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What does the public know of plastics?

Business in the year 1946 has not been too different for plastics operators than for men in any other line of endeavor. Smoothness of operation has been hampered by shortages in the supply line and general uncertainty concerning the immediate future of business trends has brought many anxious moments to all thoughtful members of the industry. In addition to these over-all problems, the emergence of plastics as a more important member of the materials family has brought various problems peculiarly applicable to plastics. Of these various problems, we believe none is more important than that of informing prospective customers of plastics' true potentialities. We were forcefully reminded of the wrong way to create a favorable impression of this industry by the following quotation which appeared on the front page of a recent issue of the Wall Street Journal.

"Plastics products run into consumer resistance in some instances. The trouble is largely psychological, explain stores while clearing out plastic compacts, lipsticks and handbags at markdown prices. People got used to identifying plastics with ersatz during the war. Now they want 'genuine' materials, it is explained. One Fifth Avenue shop says nine of ten customers prefer to wait for hard-to-get leather luggage rather than accept similar long-wearing, good-looking plastic styles."

Such a statement appearing in a highly respected business paper read largely by policy making business men is in a far different category than the sniping innuendos that are hurled at plastics products by sciolists whose words have no more weight than the paper upon which they are written. Whether the statement is true or false does not obliterate the fact that it has been made by a reporter who no doubt felt that he was quoting an authentic source.

Rather than work up a lather over the accuracy of the Wall Street Journal report we point to it as one of the most ominous danger signals confronting the plastics industry. How in the world can any product be sold if its reputation is besmirched? If a man is sent to prison in error, his reputation is ruined until he is proved innocent. Sales of plastics products will continue to be hampered by this false "ersatz" accusation unless the industry itself does something about it.

Scarcely any industry can boast of technical or production skill that will equal that found in plastics. However, production skill alone is not enough. The finest plastic article ever seen on a merchant's shelf is a total loss if no one buys it and there will be no buyer if he or she believes that it is only a substitute for the genuine article.

The day when consumers will buy anything on the shelf is about over. Scores of signs forecast a rapid disintegration of the present sellers' market. The free-spending, careless buying period when a hunk of the old League of Nations or a gold plated sow's ear could be sold to any man or woman with a fat purse (*Please turn to page 222*)

Thinking about Hydraulic Presses?

Here are ways that Baldwin can help you

FIELD APPLICATION SERVICE

When you're thinking about the jobs you want presses to do . . . your production men may get some helpful tips from a Baldwin engineer. Long contact with the field, plus Baldwin participation in research projects, equip these representatives to discuss your problems from *your* viewpoint, and cooperate in finding the exact answer to your individual need.

STANDARD PRESS LINE WITH "CUSTOM-BUILT" FEATURES

When you're thinking about the presses for the jobs you want done . . . you'll find a line of modern Baldwin presses waiting to serve you. These presses include many of the "custom-built" features, developed through years of individual press design, that you ordinarily find only in special units. They are made available on standard models through efficient production methods in the Baldwin shops.

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Baldwin press designs are based on the accumulated experience of half a century devoted to designing and building hydraulic machinery. They reflect the engineering skill gained in meeting many problems in this field. We will welcome an opportunity to work with you. The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Birmingham, Houston, Cleveland, Detroit, Pittsburgh, Norfolk.

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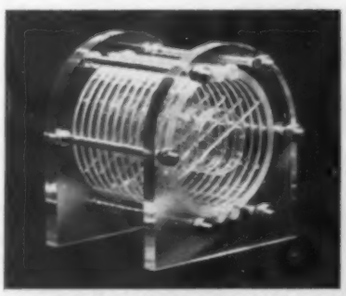
HYDRAULIC PRESSES

TONE'S RIGHT . . . COLOR'S BRIGHT . . . CABINET IS DU PONT "LUCITE"



WHAT'S NEW

This "dialyser" made of Du Pont "Lucite" enables scientists to observe more easily the progress of experiments. With this transparent unit, they can keep a constant watch on various processes, such as removing acids, recovering soluble salts, and separating colloidal materials. It's a new idea in laboratory equipment . . . made possible by the clarity, light weight, and chemical inertness of "Lucite."

Yes . . . you can now get rich tone and brilliant color both in the same radio. That is the newest accomplishment of Du Pont "Lucite."

The makers of the striking superheterodyne radio shown here selected Du Pont "Lucite" not only for its unusual beauty and glowing colors, but also for the ample, resonant tonal quality it assures as a cabinet material.

"Lucite" acrylic resin has good tensile and flexural strength, and is shatter-resistant. The excellent optical qualities of "Lucite" are evidenced in its ability to "edge-light," permitting unusual illumination effects. "Lucite" is light in weight and can be readily and economically fabricated.

This use of "Lucite" is one further evidence that a manufacturer — in any field — who knows what each Du Pont plastic can do, stands an ever better chance of turning his ideas into marketable products. Write for literature. E. I. du Pont de Nemours & Co. (Inc.), Room 3612, Arlington, N. J.

The radio shown is made by Cyart Plastics, Inc., Bronx, New York. The cabinet is hand-fabricated from sheets of colored and transparent Du Pont "Lucite."

DU PONT
Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

# of REED-PRENTICE

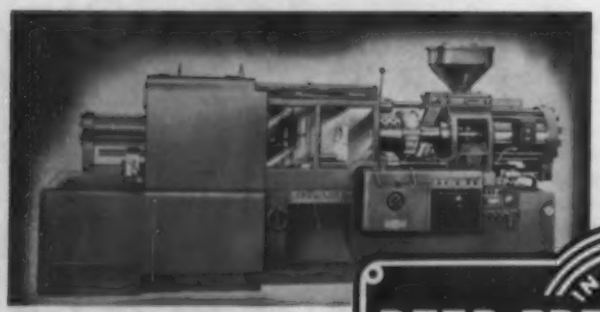
Plastic Injection Molding Machines

This "spic and span" plant of Plastic Engineering, Inc., in Cleveland instantly gives a true impression of an organization with well planned schedules, high standards of accuracy and high quality of workmanship. It is only natural that Reed-Prentice Plastic Injection Molding Machines have been selected to meet these rigid requirements and the diversified specifications of a multitude of plastic parts.

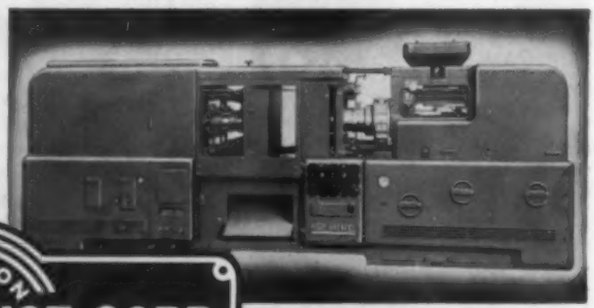
Modern materials demand modern equipment — the type of up-to-the-minute injection molding machines designed to include such features as (1) heavy frame construction (2) central control panel operation (3) automatic moving-part lubrication (4) effective safety devices (5) low maintenance (6) easy accessibility to major parts and (7) over-capacity heating cylinder — features that have warranted leadership in the industry.

A wide range for your selection is offered by the complete line of Reed-Prentice models — available in 4, 6, 8, 12, 16 and 22 Oz. capacities. Write now for mold and machine information, addressing all inquiries to Dept. D.

THE WORLD'S LARGEST MANUFACTURERS OF INJECTION MOLDING MACHINES



100-8 Oz. model has die plates 21"x25", with 325 ton mold closing pressure.



10H-22 Oz. model has die plates 30"x30", with 600 ton mold closing pressure.

INJECTION MACHINES

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THE NEW *Celanese* PLASTIC

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SURFACE.....Brilliant mold finish, requires no polishing

COLOR.....Unlimited range

ODOR.....None

HUMIDITY EXPANSION..0.4 percent

LIGHTNESS.....Specific gravity 1.17 to 1.2

MOLDABILITY.....Molding cycle is generally shorter than other cellulosics . . . Uncritical molding temperature range

Increased quantities of Forticel will be produced and become available as rapidly as new plant facilities can be put into operation. Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Ave., New York 16, N. Y., producers of FORTICEL*, LUMARITH*, CELCON†, CELLULOID*, and VIMLITE*.

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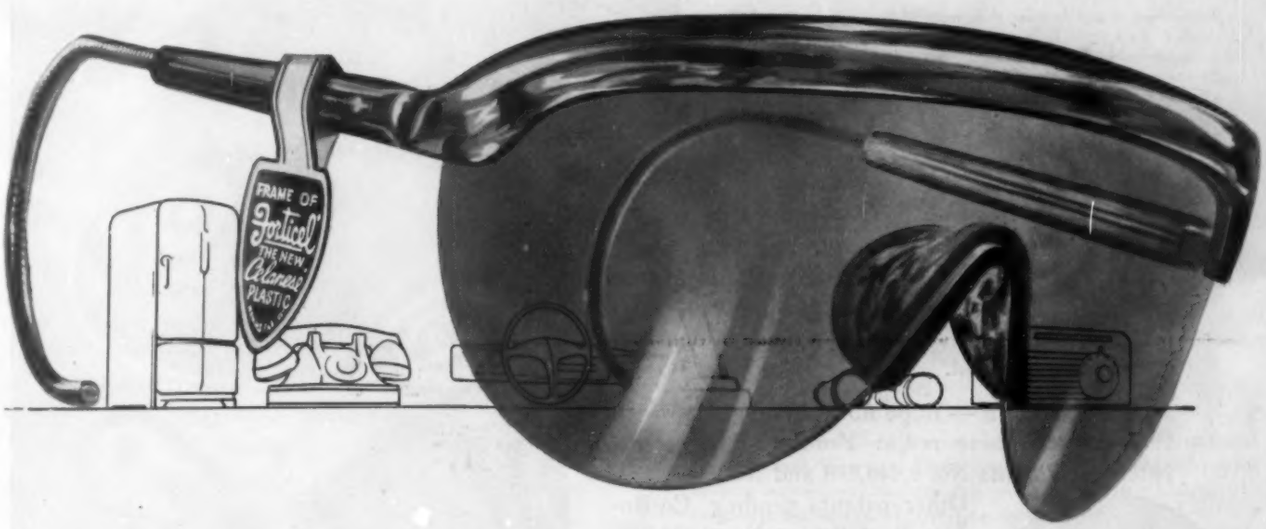

MORE FUN IN THE SUN with the SPORTGLAS—AO Polaroid type dayglasses manufactured by American Optical Company. Brow-type Forticel frame provides new wearing comfort. Look for the Forticel tag.

Celanese Synthetics* Textiles . . . Plastics . . . Chemicals

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Patented

the rope fibre plastic

Pre-formed at our factory, then molded into this *modern* baby stroller, Co-Ro-Lite facilitates production of another postwar consumer product. The essential one-piece character of Co-Ro-Lite adds great strength when compound curves are designed into the product.

OFFERS THESE REAL ADVANTAGES:

1. Continuous reinforcement of long, interlocked fibres.
2. Greater impact strength.
3. Handy preforms for molding.
4. Readily adaptable to compound curvatures.
5. Wide range of molding densities.
6. Combined rigidity and flexibility in the same piece.
7. Usable in compression, fluid pressure, and transfer molds.

Resin impregnation of the hub allows it to be polymerized to a rigid plastic. The Co-Ro-Lite Pad shown combines in one piece a rigid hub and a flexible rim . . . securely locked by the long, continuing fibres of Co-Ro-Lite.

CO-RO-LITE is equally effective with fluid pressure, flash, or transfer molds. Long, tough interlocking rope fibres reinforce all sections of the molded unit, imparting great impact, flexural, compressive, and tensile strength in a range of densities comparable to wood.

CO-RO-LITE — Rope fibres impregnated with thermo-responsive resin: Product and process patented, Patents No. 2,249,888 and No. 2,372,433. Other patents pending. Co-Ro-Lite Boat Patent No. 2,376,753.

Long draws are easy with Co-Ro-Lite. This new dinghy is seaworthy, stout, easy-towing, and strong enough to take an outboard in stride.

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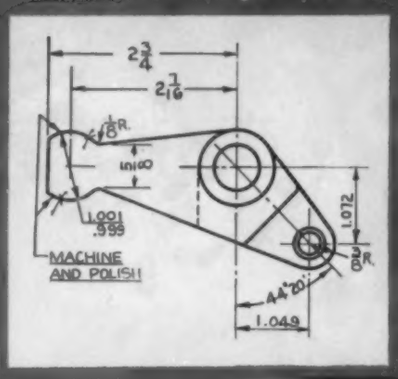
Can you Save 1½ Minutes on Each Shift Lever ?



The case history of this shift lever job emphasizes the time-saving obtained with the Milwaukee 2D Rotary Head Milling Machine. The part used as an example here, was previously milled with a special form cutter: floor to floor time, 3¼ minutes. Read this job report:

Shift Lever Material — Malleable Iron Casting.

Operation — Mill 1" diameter

Number of Pieces — lots of 300

Initial Setup Time — 20 minutes

Rough and Finish Mill — Stock removed ⅛" on the diameter

Floor to Floor Time — 1¾ minutes

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills intricate shapes in a single setup without the aid of templets or models — transmitting blueprint dimensions and outlines directly to the workpiece.

ACCURATE . . . chances for error are eliminated because there is no change in setup. Exact control of all combinations of cutting movements — possible only with this machine — transmits mathematical precision to the work.

FAST . . . initial job preparation and setup time are reduced to the minimum. Accurate performance of the machine saves operator's time and results in rapid production of work otherwise difficult to perform.

Write for Bulletin No. 1002C and complete information.

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Milwaukee 14, Wisconsin

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P-20447

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UCC

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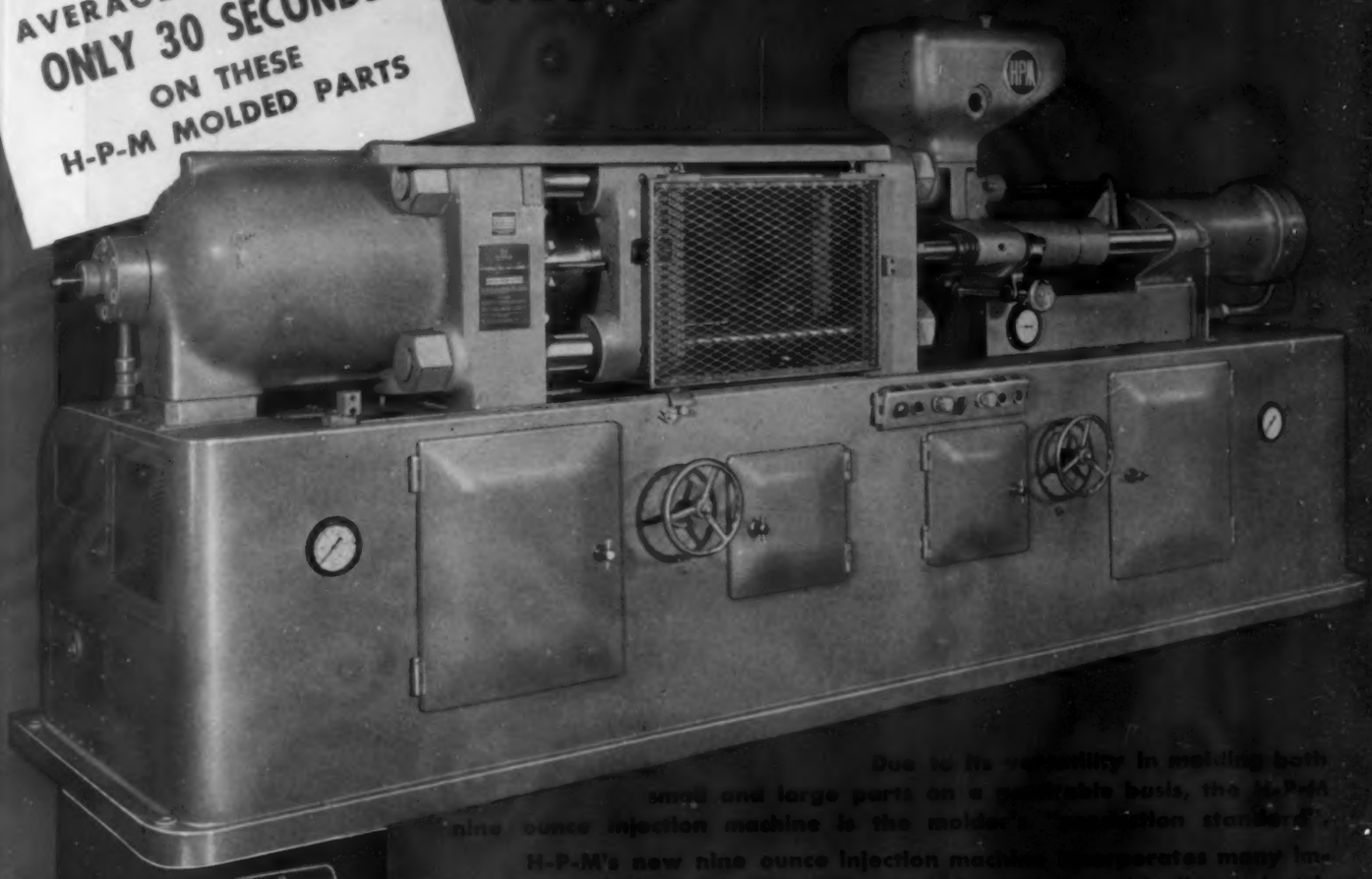
AVERAGE CYCLE TIME
ONLY 30 SECONDS
ON THESE
H-P-M MOLDED PARTS

"9" OZ.

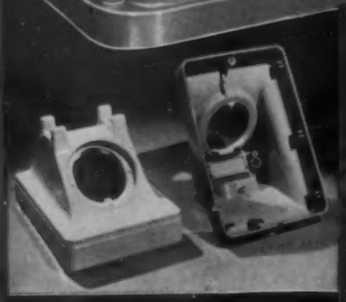
THE H-P-M [illegible] IS THE IDEAL SIZE FOR MOST MOLDING JOBS!

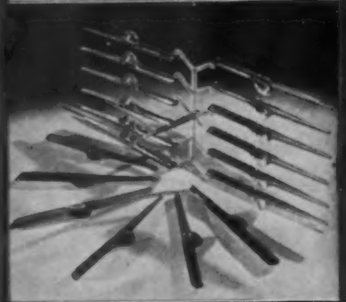


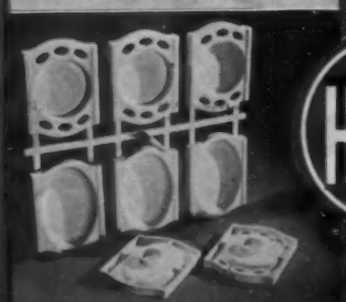
Due to its versatility in molding both small and large parts on a profitable basis, the H-P-M nine ounce injection machine is the molder's [illegible] standard.

H-P-M's new nine ounce injection machine incorporates many improved operating features including fast plasticization with direct electric heat, gravity type material feed and simplified electrical circuit. Speed of each reciprocating machine member has been greatly increased, resulting in materially lowering overall cycle time.

The H-P-M nine ounce injection machine is a completely integrated unit. In addition to the major machine members, all hydraulic pumps, valves, and controls are designed and built by H-P-M. Undivided responsibility to the user is thereby guaranteed. Investigate the outstanding production features of this new H-P-M nine ounce "all-hydraulic" unit. Write today on your company letterhead for a free copy of H-P-M Bulletin 450 describing this versatile 9 oz. molding machine.







THE HYDRAULIC PRESS MFG. COMPANY
Mount Gilead, Ohio, U. S. A.

Branch offices in New York, Philadelphia, Cleveland, Cincinnati, Detroit and Chicago. Representatives in other Principal Cities.

HPM

Self-Contained • All-Hydraulic

INJECTION MACHINES

FOR MOLDING THERMO-PLASTICS

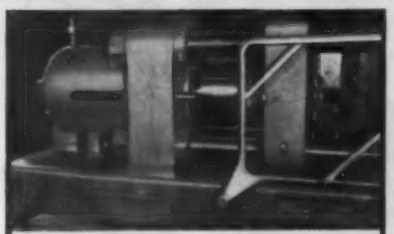
REVOLUTIONIZING PRODUCTION WITH HYDRAULICS SINCE 1877

INDURATING RESINS

Plaster of Paris, indurated with Durite room-temperature setting resins to reinforce and prevent breakage of dies, is used for forming acrylic radio dials by J. Frank Motson Company, Philadelphia, Penna. For information on your plaster problem, write for Bulletin 24.

DURITE PLASTICS INCORPORATED • 5000 Summerdale Ave. • Philadelphia 24, Pa.

LOOK FOR THESE FEATURES



STRAIGHT HYDRAULIC CLAMP

The straight hydraulic clamp assures positive clamping pressure. A separate holding pump maintains this pressure during the entire holding period. With the long stroke and opening provided deeper pieces can be molded. The large diameter hydraulic ram gives maximum support to die, keeping deflection to a minimum.

SIMPLE DIE SET UP

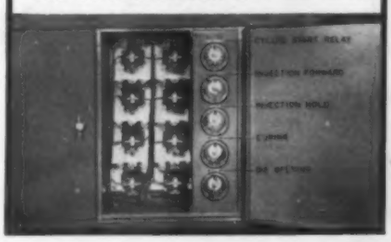
Mold set up time with the straight hydraulic clamp is reduced to a minimum. Full clamping pressure can be exerted at any point in the stroke requiring no machine adjustment to accommodate molds of different thicknesses. The mold can be closed under zero pressure with the inching valve at any desired speed, eliminating the possibility of damaging the molds in setting up.

MATERIAL FEED

The feeder is of the self-compensating type and is provided with micro-adjusting knob, permitting accurate regulation. The feeder slide receives material from the hopper and discharges to the heating cylinder through the feed bushing. The amount of charge depends on the length of stroke of the slide, which is controlled by the micro-adjustment.

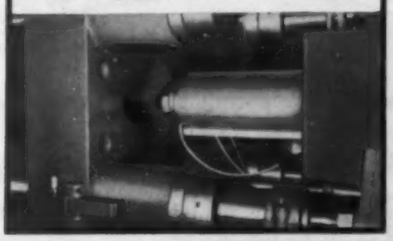
CYCLE CONTROLS

A selection of manual, automatic single cycle, or full automatic operation is possible by selector switch. Regardless of cycle selected swinging safety gate must be closed to operate machine, giving protection to the operator. Five individual motor driven timer units control the cycle when operating on automatic single cycle or full automatic control.



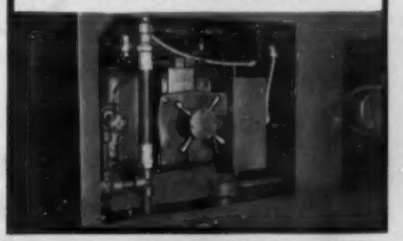
HEATING CYLINDER

Heating cylinder is of the self-sealing type fitted with fully streamlined torpedo allowing free flow of material passage through the cylinder. Serpentine heaters and zone heating control assure even controlled heating of the cylinder. Thermocouples are connected to the cylinder at different zones, each connected to a Wheelco indicating pyrometer.



INJECTION SPEED CONTROL

Speed control on 8 ounce model is by means of a flow control valve. On the 12, 16 and 28 ounce models injection speed is controlled by adjusting the volume control, which is an integral part of the radial piston pump. With this control the pump delivers a definite volume at any desired pressure and is adjustable from maximum injection speed steplessly down to zero.



Watson-Stillman Horizontal Injection Molding Machines are made in 8, 12, 16 and 28 ounce capacities. Literature is available.

2129

WATSON-STILLMAN
HYDRAULIC MACHINERY DIVISION

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MANUFACTURERS OF THE MOST COMPLETE LINE OF HYDRAULIC MACHINERY

YES!
we actually

STRETCH
paper!

The extreme light weight of our XFL saturating paper actually produces miles, not feet, per ton. Only weighs 1½ pounds per thousand square feet per point of caliper. (Example—caliper .020 weighs 30 pounds per thousand square feet.) Specifically recommended for latex saturation for the manufacture of artificial leather, etc., because of its uniformity, extreme softness and flexibility. Also recommended as a base or core stock for plastic impregnation where a sheet for post forming, scoring or punching is required.

Write for samples and prices.

"XFL" SATURATING

Originators • Creators

HUMMEL-ROSS FIBRE CORPORATION

Hopewell, Virginia, U. S. A.

* RICHARDSON MEANS *Versatility* IN PLASTICS

Shake Hands with a Richardson Plastician!

He's one of many in the Richardson organization. They combine the best qualities of consultant . . . engineer . . . scientist . . . salesman . . . designer. If you have a problem in plastics, these men take the *problem* out of it . . . for you.

Richardson Plasticians form a flying squadron of skilled technicians. They are men whose varied educational backgrounds and practical industrial experiences equip them to utilize fully Richardson designing, molding, laminating, rubber-working and our own tooling facilities. It's a great team. No wonder our customers keep coming back for more.

INSUROK *Precision Plastics*

***RESEARCH**
. . . a continuous transformation of possibilities into practical ideas in plastics.

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. . . Artistic visualization. Creative engineering. Practical planning for efficient plastics production.

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. . . Complete machine shop facilities for manufacturing dies, molds and tools.

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. . . Sheets, rods, tubes. Standard NEMA grades; over 700 special grades.

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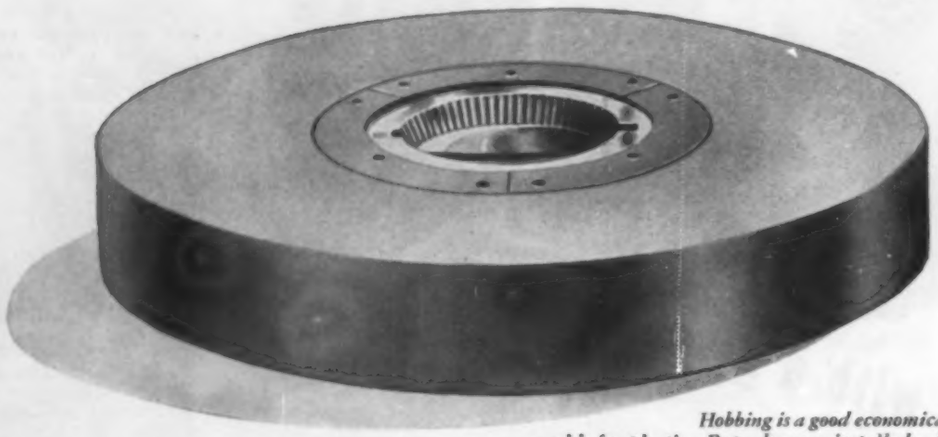
Squeeze Play

for Better Plastics



Hobbing is a good economical way of producing many molds for plastics. But when we installed a hobbing press in our own plant, back in 1924, the idea made history. Made sense, too. It gave us a unique, complete toolroom—with full control over all mold production.

WHEN AN INDUSTRY keeps improving production techniques—keeps producing larger pieces, from materials of more universal but more precise characteristics—and keeps doing it faster—that's progress. What's more, that's Plastics!

We're showing you our contributions to progress in plastics for just one reason. These ideas all benefitted *our* customers *before* they became general molding practice. They paid off—in actual figures.

Why not give your firm—today—the advantage of some of tomorrow's bright ideas? Send for your free copy of "A Businessman's Guide to the Molding of Plastics"—or ask for a Kurz-Kasch engineer.

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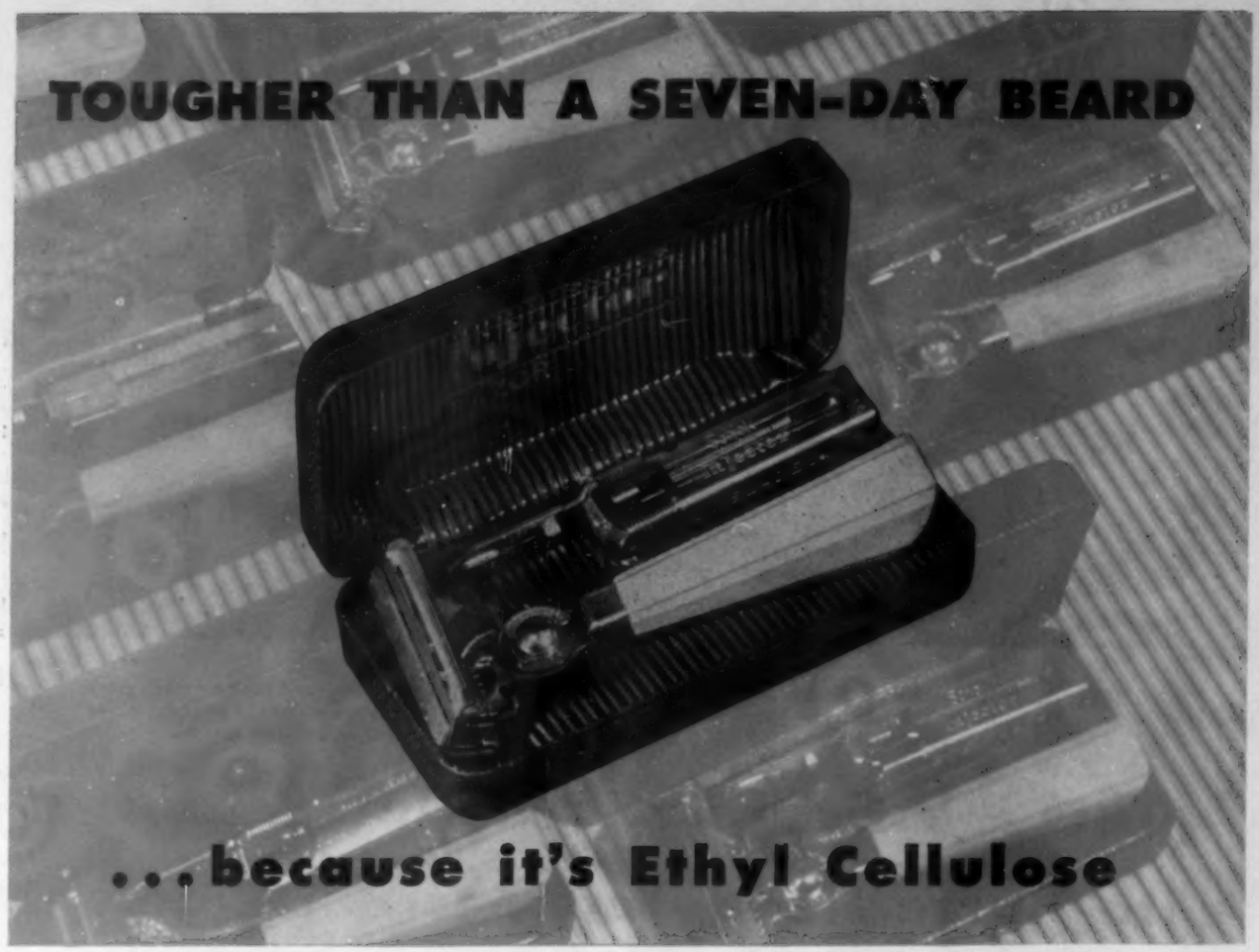


Handle molded by Mack Molding Company from Chemaco's Ethyl Cellulose

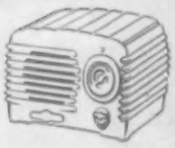
Schick's choice of ethyl cellulose for the handle of its famous Injector razor has resulted in many improvements for manufacturer and consumer.

One outstanding property of ethyl cellulose is its resistance to cracking and chipping, even when dropped on hard surfaces. Another is its excellent dimensional stability, which assures a tight fit between plastic handle and metal through long periods of use, including cleaning in hot water. Pleasant to the touch, these new handles are made in dark blue, light blue, and brown mottle colors that retain their attractive appearance

If your products have handles, or are frequently handled, it will pay you to know *more* about the serviceability and economy of ethyl cellulose molded parts

Ethyl cellulose flashlight cases, proved best for Army use, now first civilian choice

Ethyl cellulose radio cabinets have high impact strength; excellent acoustical properties



Ethyl cellulose tool handles are tough, colorful, and pleasant to the touch

HERCULES

CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

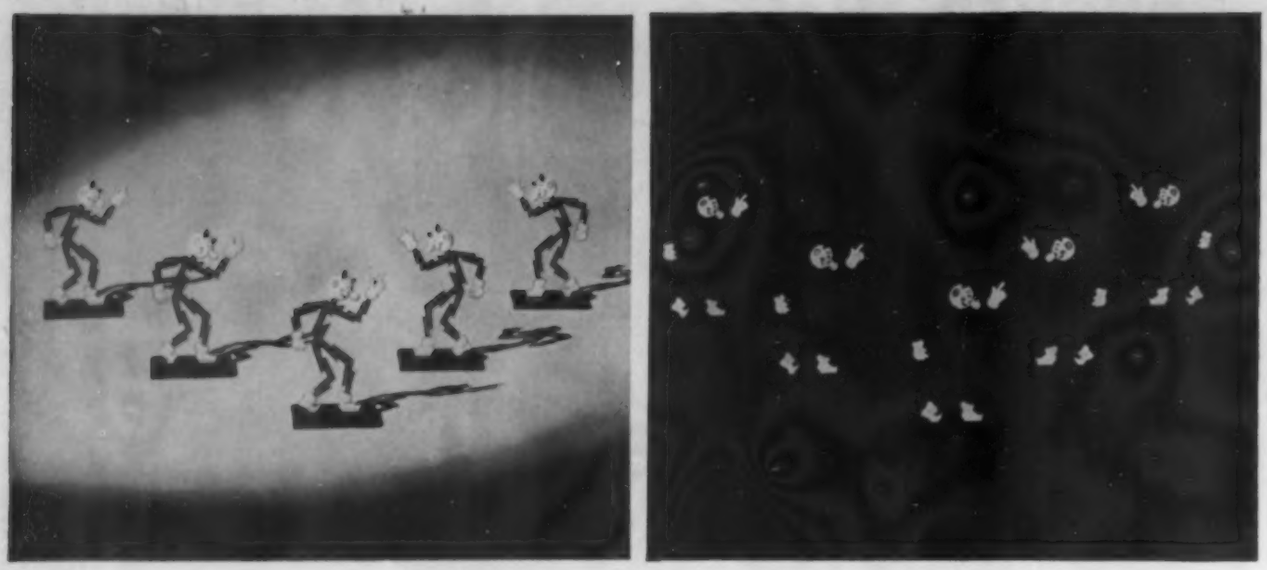
For general-purpose production plastics

Hercules does not make plastics or molding powder, but supplies the high-quality cellulose derivatives from which they are made. For data, please write to

HERCULES POWDER COMPANY INCORPORATED 916 Market Street, Wilmington 99, Delaware

EP-73

THIS "*Glowing*" TRADE-MARK helps to sell MORE LIGHT!



THIS is Ready Kilowatt Your Electric Servant—the trade-mark around which the power and light company story of service is built. For this figure that glows in the dark, the head, gloves and boots are molded of phosphorescent Lustron (Monsanto Chemical Co.) by Mack Molding Co. The body is of dyed cellulose acetate.

This Plastic Item Is Made "*Luminous*" with Horse Head* Luminescent Pigments

APPROPRIATELY suited to the promotion of electric light and power, the "glowing" phosphorescent figure, "Reddy Kilowatt," demonstrates another practical application for luminescent plastics, in which Horse Head Luminescent Pigments provide the "glow." This item makes an interesting, unusual novelty as well as a part of a dark-time display—just one more example of how phosphorescence can be used to add extra features to products and to product sales-movers.

Among many other useful applications for *phosphorescent* pigmented plastics may be mentioned lampshades and fixtures, electric switch and outlet plates, door knobs and hardware, radio cabinets and dials, house numbers, safety signs, flashlights, table-tops, curtains, slippers and apparel accessories. The *fluorescent* types are readily applied to decoration and displays, radio, aviation and automotive instrument dials.

Our technical staff is ready to work with you, your molder or plastics supplier on any phase of luminescent plastic applications.

The New Jersey Zinc Company does *not* manufacture plastics—we supply Horse Head Fluorescent and Phosphorescent Pigments for use by plastic manufacturers in producing luminescent cast and calendered films and sheets, molding granules and powders, and laminating materials. Names on request.

*Reg. U. S. Pat. Off.

THE NEW JERSEY ZINC CO., 160 Front Street, New York 7, N.Y.

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MOLDED MASTERPIECES WITH MALE-APPEAL

HERE'S something that is really new in the male toiletries line.

It's a complete, beautifully packaged shaving and toilet set for men of good taste . . . men who are used to paying more in order to be sure of the finest. The manufacturer is one of our nation's best-known, conservative firms.

As you can see from the illustration, these products are exquisitely packaged in rich, black, molded plastic containers . . . custom molded by Norton Laboratories of a general-purpose phenolic plastic.

For years, Norton's experienced design engineers have been working closely with progressive, plastic-minded manufacturers representing practically all fields of industry . . . from cosmetics to household appliances.

Couple this rich background of successful product development experience with the complete facilities for compression and injection molding which are available here and you can easily understand why leading concerns everywhere look to Norton for all their custom molding.

Why not send detailed description of your plastics problem? Norton Laboratories, Inc., Lockport, N. Y. *Sales Offices: 347 Fifth Avenue, New York City; 9 South Clinton Street, Chicago.*

NORTON *Laboratories, Inc.*

COMPRESSION AND INJECTION MOLDING

FOR MOLDING PLASTICS...

DISSTON MOLD STEELS

Manufactured to meet your individual needs

Whatever your plastics mold requirements, you are certain to find among these three specialized Disston Mold Steels one that will meet your needs exactly.

FOR DIFFICULT SHAPES AND SHORT RUNS

PLASTIRON . . . a low carbon steel that is easy to work, withstands extreme hobbing, and is exceptionally well suited for intricate forms.

FOR GENERAL SERVICE AND MEDIUM RUNS

PLASTALLOY . . . a low carbon steel having the right amount of chrome and nickel to assure great core strength and long wear, yet permit easy hobbing.

FOR HARD SERVICE AND LONG RUNS

PLASTIKUT . . . a "cut mold" steel for maximum core and case strength. Must be machined instead of hobbed, but because it stands up extra long in service, PLASTIKUT is very economical.

ALL PROVIDE THESE ESSENTIALS

Each of these Disston Mold Steels is composed of carefully selected raw materials and produced in Disston electric furnaces. Modern steel practice keeps every process under rigid control. Each is melted and hot-worked with great care . . . is carefully inspected to assure freedom from porosity and inclusions . . . is uniformly sound, carburizes evenly, and produces unusually smooth cavities.

● If you have a special mold or hob problem, let Disston engineers and metallurgists help you solve it. You may consult them freely, without charge or obligation . . . and in confidence.

Write for Folder Contains much useful information which may help you get best results in your use of mold and hob steels.

STEEL . . . Everybody who wants to obtain steel can help himself to get it by immediately starting scrap into the channels that serve steel mills.

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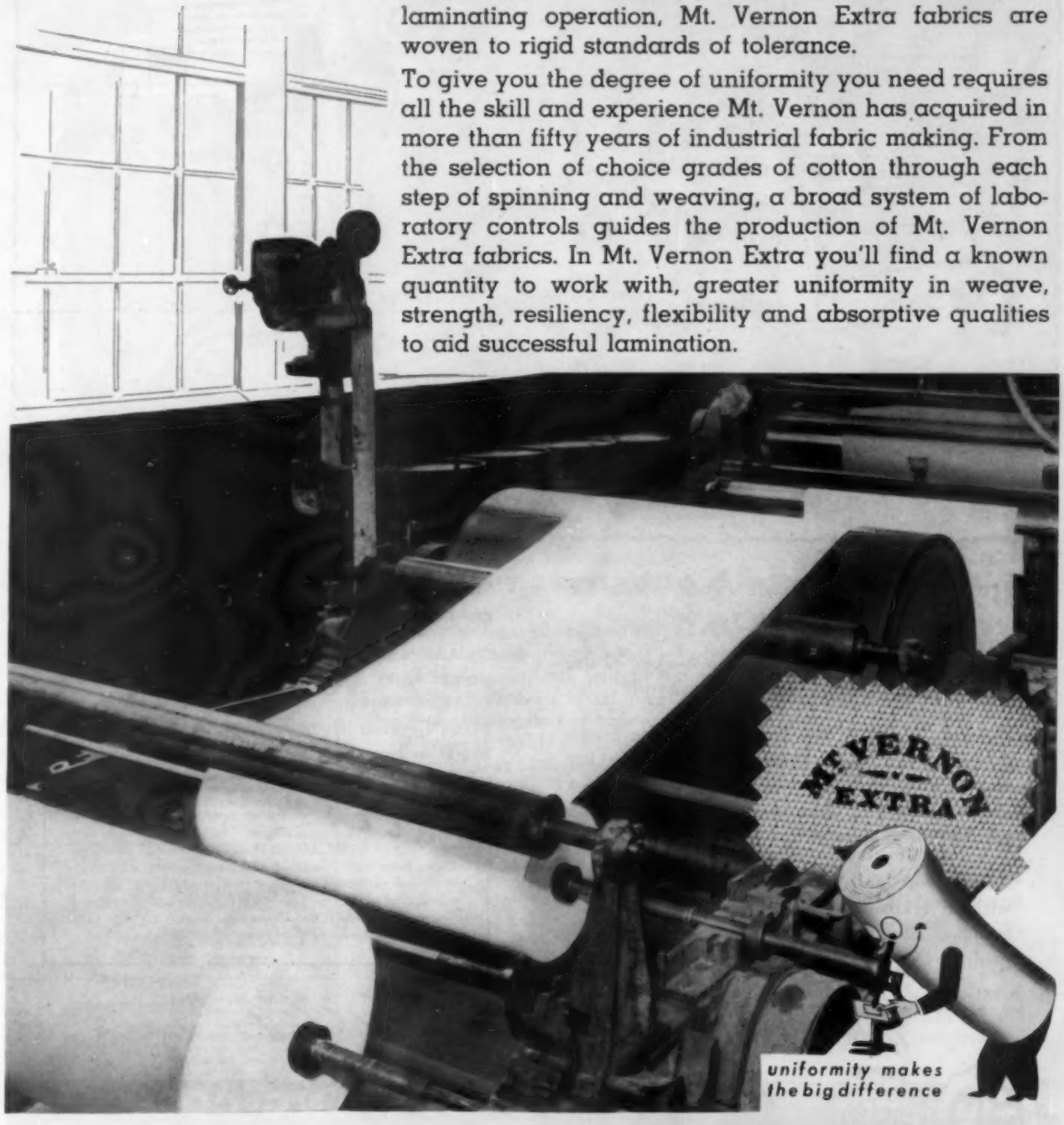
Fabric Uniformity Aids Successful Lamination

Because fabric uniformity is vital to the success of your laminating operation, Mt. Vernon Extra fabrics are woven to rigid standards of tolerance.

To give you the degree of uniformity you need requires all the skill and experience Mt. Vernon has acquired in more than fifty years of industrial fabric making. From the selection of choice grades of cotton through each step of spinning and weaving, a broad system of laboratory controls guides the production of Mt. Vernon Extra fabrics. In Mt. Vernon Extra you'll find a known quantity to work with, greater uniformity in weave, strength, resiliency, flexibility and absorptive qualities to aid successful lamination.



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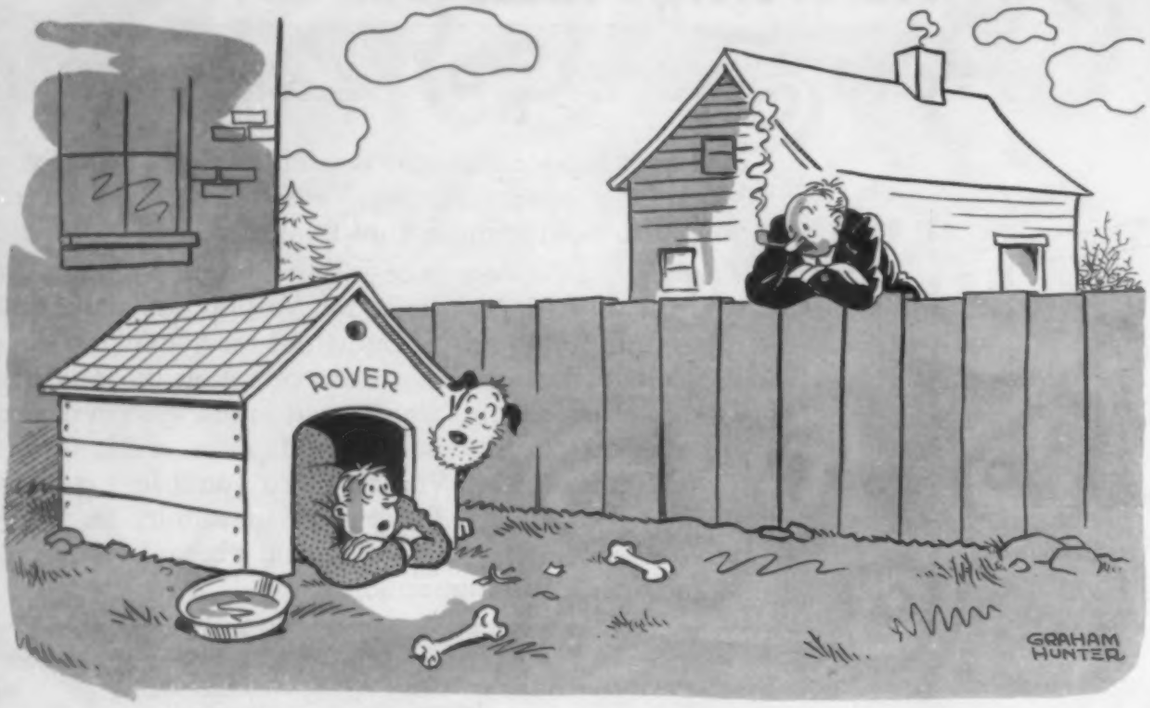

"Yeah, I Forgot to Buy the Plastic Articles My Wife Wanted"

BUT don't forget to consult a *good* molder for the molded plastic parts you need.

It really doesn't cost any more to use one of the *best* molders — like *Boonton*, for example!

Boonton *is* one of the best because the group down at Boonton has been devoting its thinking to the elements of good plastic molding for 25 years now. That's a lot of years for an industry so young.

And — you don't spend 25 years at one thing without learning a lot. Of course, you make mistakes along the way; but if you're alert, you profit by those mistakes and that gives you "Know How." That's how we account for our good position in the field.

Next time you're considering using molded plastic parts, try working with the Boonton group. It's like working with the men in your own plant because *Boonton* men really take *your* needs to heart.

FREE! *We've got something you might like to have — a special Decimal Chart, 3-ring punched to fit your notebook. This chart gives diameter, area, and circumference of circles, and surface and volume of spheres for each additional fractional increment (1/64) of diameter. Write us on your company letterhead for your copy.*

If it can be Molded, Boonton can Mold it —We Hope

BMCD

SPI · SOCIETY OF THE PLASTICS INDUSTRY

BOONTON MOLDING COMPANY

MOLDERS OF MOST PLASTICS BY MOST METHODS

FOR OVER 25 YEARS
CUSTOM ENGINEERS
OF MOLDED PLASTICS

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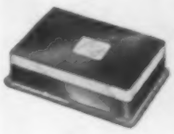
FACTORY—BOONTON, New Jersey

Look what Aluminum-Plastics teamwork can do!

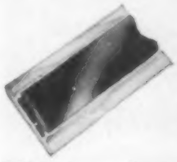
MECHANICAL strength can be added to molded parts without burdensome weight. Fastening inserts, or structural reinforcements, are light, strong; available in many cases from stock.

ELECTRICAL conductivity of aluminum is high. Perhaps you're thinking about a molded plastic electrical part where aluminum inserts provide the necessary conductivity. They're strong, too!

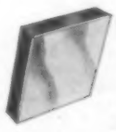
THERMAL properties of aluminum are excellent. Let's say you're designing a plastic product which must be air-cooled. You might use aluminum discs, molded in, as above.



DECORATIVE values of aluminum are a long story in themselves. Use it plain, or with frosty or mirrorlike Alumilite (patented process) or colored finish. Remember, it's light!



EXTRUSIONS of plastic combined with extrusions of aluminum? Why not? One supplements the other, in beauty and strength. Alcoa Aluminum is available in many stock shapes.



LAMINATED plastics can be faced with aluminum sheet for a new idea in modern materials. Or, why not inset Alcoa Aluminum decorations in your dark laminates? Attractive!

FORMED plastic sheets team up well with Alcoa Aluminum, as in this navigator's dome. The whole assembly is light, strong, easy to mount. Is there a household idea here?

CHEMICAL properties of aluminum supplement those you like to stress in plastics. Can it help you in products for textile, process, petroleum, pharmaceutical, food industries?

Better change to Alcoa Aluminum

It's bad enough when inserts "flex their muscles" and crack a molded part fresh from the mold. It's worse still when they wait until the molding is assembled, sold, in service. And that's the chance you take whenever you use a metal insert with a marked difference in expansion coefficient from that of your molding material.

When you tackle a job where inserts are involved, check the expansion coefficient of your molding material against those of various Alcoa Aluminum Alloys. You'll find one that will be just right to hold the insert tightly in place, without damaging stresses. That's the alloy to name when you ask your insert supplier to "make it of Alcoa Aluminum!"

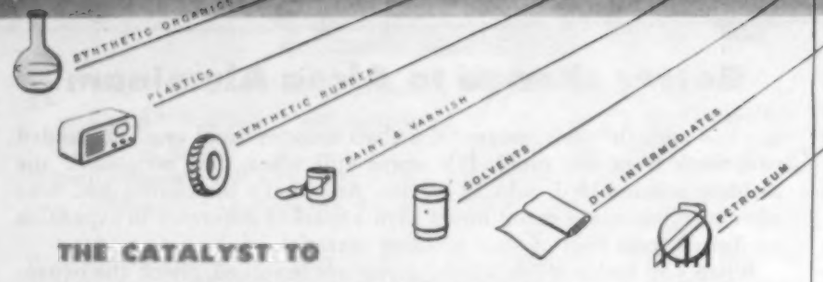
The list at the left indicates how closely and profitably plastics and aluminum can work together... how, in heat behavior as well as other properties, Alcoa Aluminum is truly "Plastics' best friend in metals". ALUMINUM COMPANY OF AMERICA, 2175 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

IN EVERY COMMERCIAL FORM

General Chemical Fluorine Research Presents...



THE CATALYST TO CHART NEW COURSES FOR AMERICAN INDUSTRY

Boron Fluoride Etherate . . . valuable catalytic chemical of wide ranging potentialities for American Industry!

This new liquid fluorine compound has a multitude of uses. Technical literature—filling volumes—contains extensive data on the reactions catalyzed by BF_3 as well as by its complexes with other organic molecules. Repeated reference is made to its superiority to other catalysts since reactions are moderated and fewer undesirable by-products result.

Outlined at right are some of the principal applications for BF_3 as a catalyst. Perhaps they indicate ways in which you can utilize a chemical of these characteristics in your development or production program.

Boron Fluoride Etherate is commercially available in drums. For full information, contact General Chemical Company, Fluorine Division, 40 Rector Street, New York 6, N. Y. When writing, if you outline your proposed application for this new catalyst, the technical experts of our Fluorine Division can work with you toward an early solution of your problem.

GENERAL CHEMICAL COMPANY
40 RECTOR STREET, NEW YORK 6, N. Y.

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BASIC CHEMICALS
GENERAL CHEMICAL COMPANY
FOR AMERICAN INDUSTRY

Physical Properties

Formula:

C_2H_5 > O.BF_3
C_2H_5

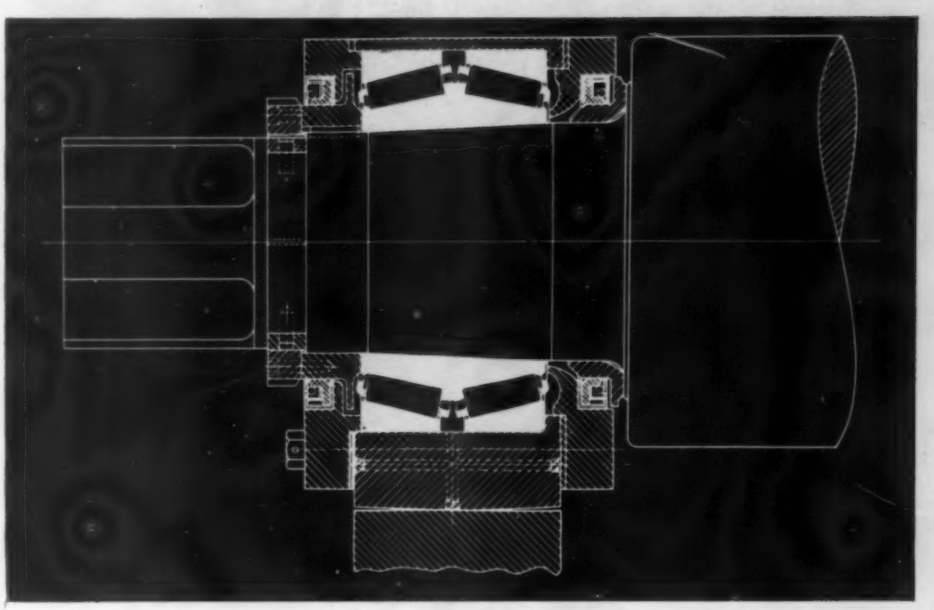
Mol. Wt.	141.9
Melting Pt.	Less than −60°C
Boiling Pt.	125°C
Spec. Gr.	1.14 at 25°C
%BF_3	47.8% min.

Some of the Principal Reactions Catalyzed by BF_3

1. Polymerization of unsaturated compounds such as olefins, diolefins, vinyl ethers, fatty oils, and terpenes. The products may be solid polymers useful as plastics or liquids as in the bodying of drying oils for paints and varnishes.
2. Condensation of aromatic nuclei with olefins and diolefins, paraffins, and olefins, and aromatic nuclei or olefins with acids.
3. As a cyclizing agent for rubber.
4. As an esterification catalyst.
5. As a catalyst in the synthesis of aliphatic acids from alcohols and carbon monoxide.
6. As a promoter and dehydrating agent in the sulfonation and nitration of aromatic compounds.

Give your Plastics Calenders

TIMKEN *balanced proportion* Bearing Benefits



TIMKEN BEARING EQUIPPED

Put the new Timken DIT Type Balanced Proportion Bearings on the rolls of your plastics calenders and watch calender performance improve!

These bearings assure increased roll rigidity with minimum roll deflection under all load conditions because they make possible greater roll neck diameter and strength, plus maximum radial, thrust and combined load capacity.

The simplicity of the new bearing mounting, as shown in the drawing, makes assembly and removal of the bearings from the roll necks much easier.

The trade-mark "TIMKEN" stamped on the cup and cone of every bearing identifies it as the product of The Timken Roller Bearing Company. Make sure this trade-mark appears on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

PRESENTING

Gaytex

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Because the plastic coating that protects Fisher GAYTEX is invisible... has *no* shine or odor... this carefree, modern fabric has a host of uses beyond the "run of the mill." Fisher GAYTEX is waterproof, stainproof, yet looks, and feels like the original fine textiles from which it is made... drapes as smoothly, needs no special stitching.

Use nationally-advertised GAYTEX for slipcovers, draperies, and upholstery. Available in plain colors, harmonizing stripes and bold prints by one of America's top designers, Marion V. Dorn. Write... wire... or telephone (Hancock 5610) today for samples and information to Dept. M2.

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Fisher PLASTICS

FISHER PLASTICS CORPORATION
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Surer to the Fingers...
Softer to the Shoulder

* *Gun parts pictured herewith were molded for O. F. Mossberg & Sons, Inc.*

—and Less Costly to the Gun Maker!

These plastic gun parts as injection molded of black Acetate, serve two masters . . . the gun maker and gun owner — and serve them both admirably well! To the gun maker, these precision-molded plastic units are weight-savers, eliminate heavy metal and costly machining. To the gun owner, the one part *adds feel to the fingers* — while the other *takes away the feel of recoil!*

Whether the projected plastic application be industrial, electrical or general, our experienced engineering staff welcomes the opportunity to sit in with product designers and manufacturers. Preliminary discussions assure proper mold design, the most advantageous processing procedure, and correct material choice. In that Consolidated's type of follow thru also saves you time and money, your inquiry is invited!

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MOLDED PRODUCTS *Corporation*
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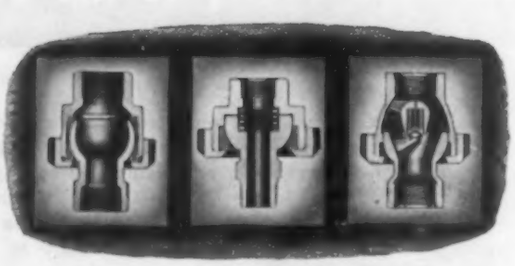
Constant vibration is the persistent enemy of a fluid conveying system... often unnoticed until the damage is done. Barco Flexible Joints neutralize this harmful action, providing protective responsive movement... compensating for contraction and expansion... guarding against leaks and breaks. For detailed information applying to your particular problem, write to Barco Manufacturing Co., Not Inc., 1809 Winnemac Avenue, Chicago 40, Illinois.



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Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

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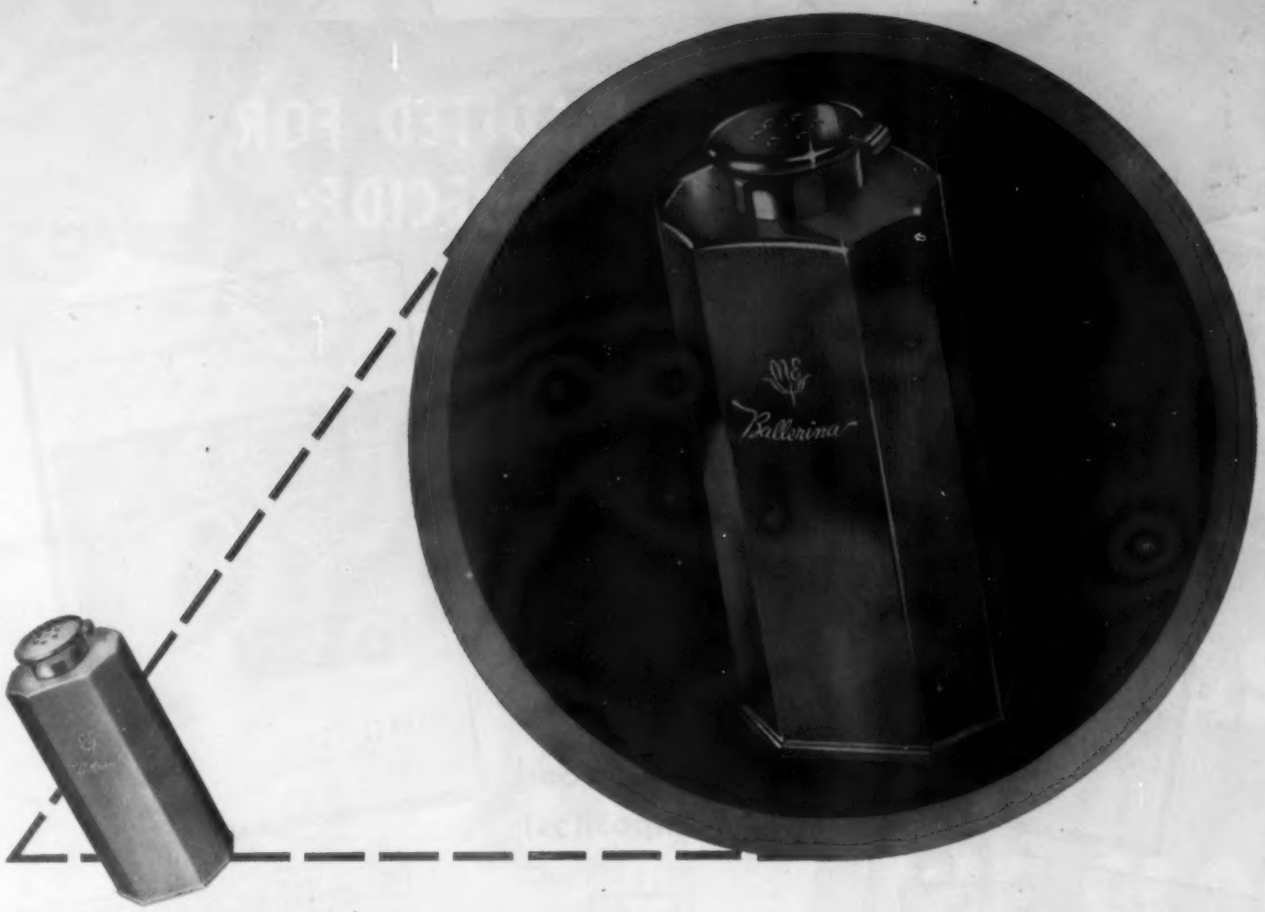
"MOVE IN EVERY DIRECTION"



Make MACOID Your Headquarters for Plastics "Know-How"

Industries all over the country make MACOID their engineering headquarters for plastics. The talcum powder container shown above is a typical example of how MACOID engineers worked with a client's designers to put their plans into plastics.

In the development of this job, careful pre-testing of materials was carried on in MACOID'S own laboratories. MACOID designed and engineered the dies to permit the molding to close tolerances necessary to facilitate the assembly of top and base sections. An air-tight weld was accomplished by cementing with a solvent.

MACOID will do a job for you, too. Consult MACOID'S engineering staff to determine if plastics are practical for your product and for help with your plastics problems.

DETROIT MACOID CORPORATION

Originators of Dry Process Plastics Extrusion

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EXTRUSION AND INJECTION MOLDING

IN THE METALWORKING INDUSTRIES

THE MAGAZINE EDITED FOR THE MEN WHO DECIDE:

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(WHOSE MATERIAL)

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or
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Composites!

What Method?

(WHOSE EQUIPMENT)

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or
Punching!

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THE METALWORKING INDUSTRIES' ENGINEERING MAGAZINE
METALS ALLOYS

THE CASE OF THE CLOCK

held no mystery for us

—and will hold no mystery for you either when you see how these beautiful McClintock clocks sell over the counter in their sparkling Creative housings. If your need is an elaborate housing, panel or just a knob or bushing, send your specifications to Creative for an analysis.

Plastics Specification Quiz: If it's not convenient for you to send blueprints or samples, write for our "Plastics Specification Quiz". Two minutes with this Quiz will enable you to tell us which of your products may be improved by the use of plastics.

Creative

PLASTICS CORP.

60 Kent Avenue Brooklyn 5, N. Y.

TO ATTAIN excellence in plastic molding, many steps—each an essential part of the whole process—must be followed through accurately and thoroughly.
Every step of the way—designing, mold making, molding, and finishing—calls for the highest skill and experience, plus the proper plant facilities for efficient production. Combined, these operations can result in quality molding... plastics that "measure up" in performance, appearance and cost.
MACK experience and proven methods, plus three completely equipped plants, offer plastic molding that qualifies. Your inquiries are solicited; address Mack Molding Company, Inc., 100 Main Street, Wayne, N. J.
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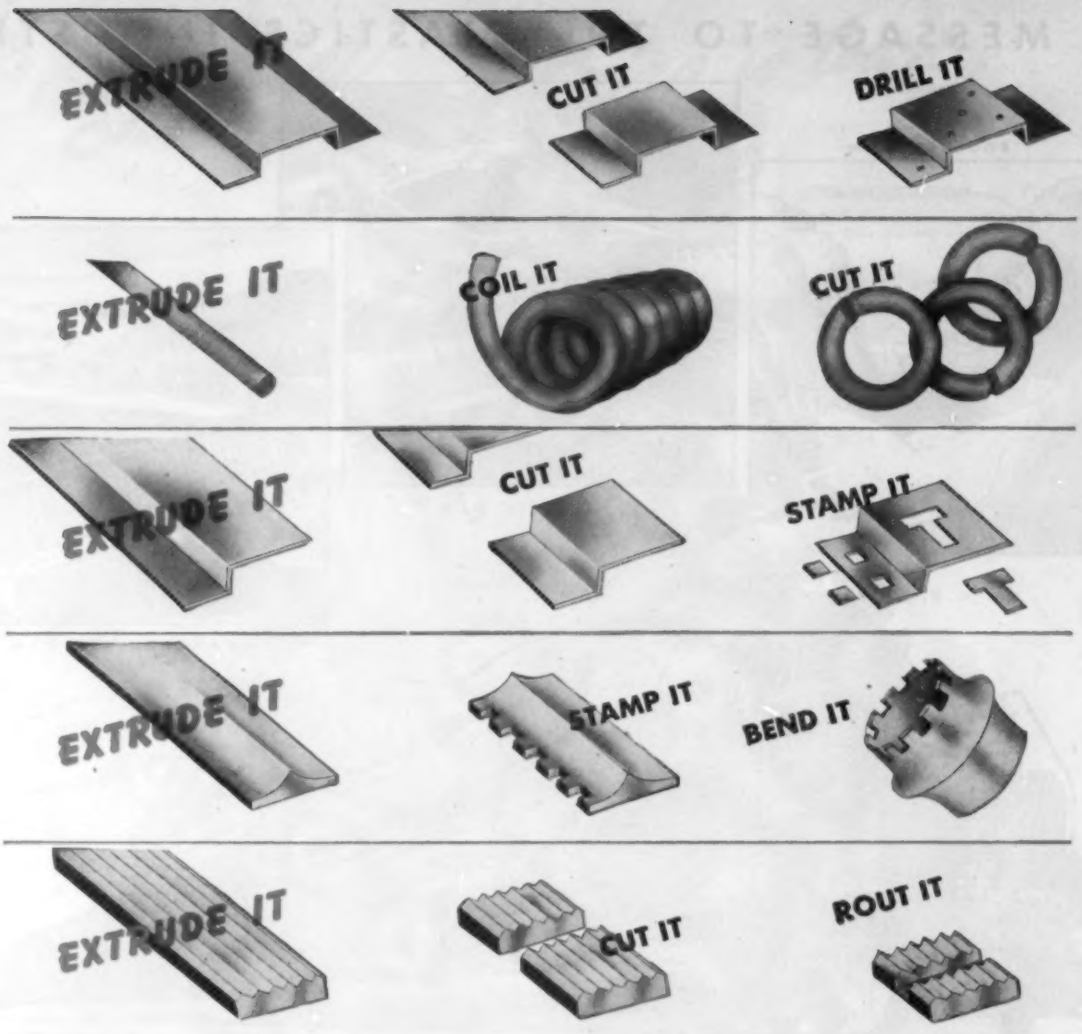

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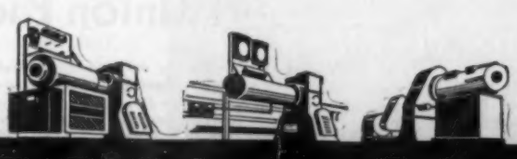
IS . . . EXTRUDE IT!

When you plan your product for production, it pays to plan to *extrude* as many of the plastics parts as possible. Extrusion is a continuous process; you save manufacturing time. Extrusions have a smooth, clean-cut finish; no buffing or polishing. Variety of shapes which can be produced to close tolerances and with uniform physical properties on NRM Extruders is virtually limitless.

Write for complete data on America's most complete line of plastics extrusion equipment.



NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

A MESSAGE TO THE PLASTICS INDUSTRY

More POWER to You

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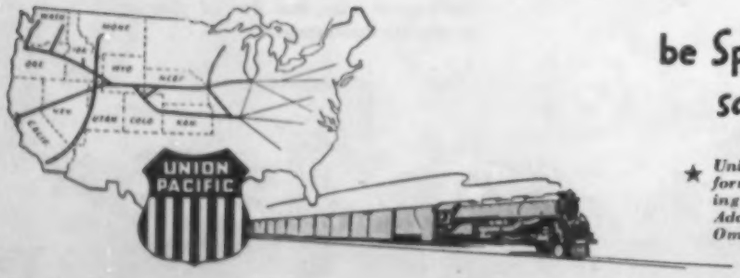
Giants of the rails, the Union Pacific "Big Boy" locomotives provide freight transportation power over the Strategic Middle Route.

Power, light, and efficient transportation . . . combined with a wealth of raw materials and adequate "growing space" . . . offer unusual opportunities for industry in the Union Pacific West.



be Specific – say "Union Pacific"

★ *Union Pacific will gladly furnish confidential information regarding available industrial sites having trackage facilities in the territory it serves. Address Industrial Dept., Union Pacific Railroad, Omaha 2, Nebraska.*

UNION PACIFIC RAILROAD

The Strategic Middle Route

Santa Claus is going to town with Lustron

Old Santa knows his stuff, all right! The brightest, the keenest, the most eye-popping presents in his bulging $200,000,000 toy bag this year are going to be of beautiful, Lustron plastic.

Santa knows he can get faithful models of jeeps, railroad coaches, planes . . . down to the last rivet head . . . faster and more economically with Lustron, than with any other material.

He knows he can get more wonderful colors in Lustron, too . . . colors that won't come off. He knows his dolls and blocks and toys are all more attractive, smoother, lighter, stronger, and more sanitary when he molds them of Lustron.

MONSANTO
CHEMICALS AND PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Yes, Santa's right . . . and what thrills young hearts will appeal to millions of others who are going to receive beautiful Lustron presents . . . the plastic with the Christmas joy molded in.

MONSANTO CHEMICAL COMPANY, St. Louis 4

District Offices: New York, Chicago, Boston, Detroit, Charlotte, Cincinnati, Birmingham, Los Angeles, San Francisco, Seattle, Springfield, Montreal, Toronto. Lustron: Reg. U. S. Pat. Off

What is YOUR problem?—Helping to create better toys is only one small spot where Monsanto Chemistry is contributing year 'round to better living. If you have a product problem in your industry, no matter what that is, why not see if Monsanto hasn't the answer among its hundreds of chemicals and plastics . . . or in its vast chemical experience? Letters will receive prompt attention.

1. Design Center, Flushing, L. I., N. Y. (Xmas tree ornament)
2. J. Donald Biever, molded by Precision Plastics Co., Philadelphia, Pa. (builder, blocks)
3. Bachman Bros. Inc., Philadelphia, Pa. (fence)
4. Lionel Corporation, Irvington, N. J. (train)
5. Irwin Corporation, New York, N. Y. (auto, gun, train)
6. Knickerbocker Plastics, Glendale Calif. (rattles, clown, boats, wagon)
7. Plastic Art Toy Corp., Rutherford, N. J. (dishes, furniture)
8. Lakone Company, Aurora, Ill. (feeding dishes)
9. Harmonic Reed Corporation, Philadelphia, Pa. (harmonica)
10. Ideal Plastics Corporation, L. I. City, N. Y. (bomber, truck, trailers)
11. Pyro Plastics Corporation, Westfield, N. J. (baby utensils)
12. Meidell Plastics, Chicago, Ill. (darts)

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THE NAME YOU CAN DEPEND ON IN PLASTICS

There's compelling beauty in Styron! And in this Dow-developed plastic, it's beauty that lives on! Time's touch is light on Styron. In clock cases you'll find Styron's burnished brightness keeps pace with the years. You'll learn, too, that Styron is stable, keeps its shape—that it is meant for service. Styron is imparting new life and color—and usefulness—to hundreds of products. You're seeing more of Styron everywhere. That's because manufacturers in growing numbers attest its worthiness in many things—for you!

Other Dow plastics include: Saran, for textile and screen cloth; Ethocel, for durable molded products; Ethocel Sheeting and Saran Film for transparent packaging.

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that makes the usual models as out of date as the Dodo

See how we've overcome all the old shortcomings!

Compare these additional new features!

Self centering type holder palate will take up to 4" x 6". Die holder palate will take larger die

Adaptable for all types of plastics.

1. Hand lever may be instantly set at any of 14 positions, to suit convenience of operator.
2. Heavily knurled, self-setting feed rolls give sure pull. No slipping—no waste. Adjustable from 0" to 5½".
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4. Quick guide adjustments for register feeding so that you get the impression exactly where you want it.
5. Lock handle for instant height adjustment of die or type up to 8".
6. Ratchet and gear of hardened steel for long life.
7. Stroke adjustable to any height from die to impression plate.
8. Ball handle on impression bar for natural grip.
9. Correct engineering of rigid frame prevents spring.
10. A weight, counter balancing moveable parts, makes for ease of operation.
11. 2 way adjustments for feat guide control.
12. Leaf roll widths up to 6".
13. Thermostatic heat control assures exactly the right temperature for any job. This is imperative if perfection and economy are to be obtained.
14. Sliding bed for quick change from one job to another.
15. Strong intelligent construction throughout insures long life and economy.
16. Work platform—12" x 12". Larger platform available.
17. Pedal for foot operation available.
18. Dial tables available.

Always complete stocks of leaf, foils, type, dies and accessories.

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GOOD WILL TO MEN
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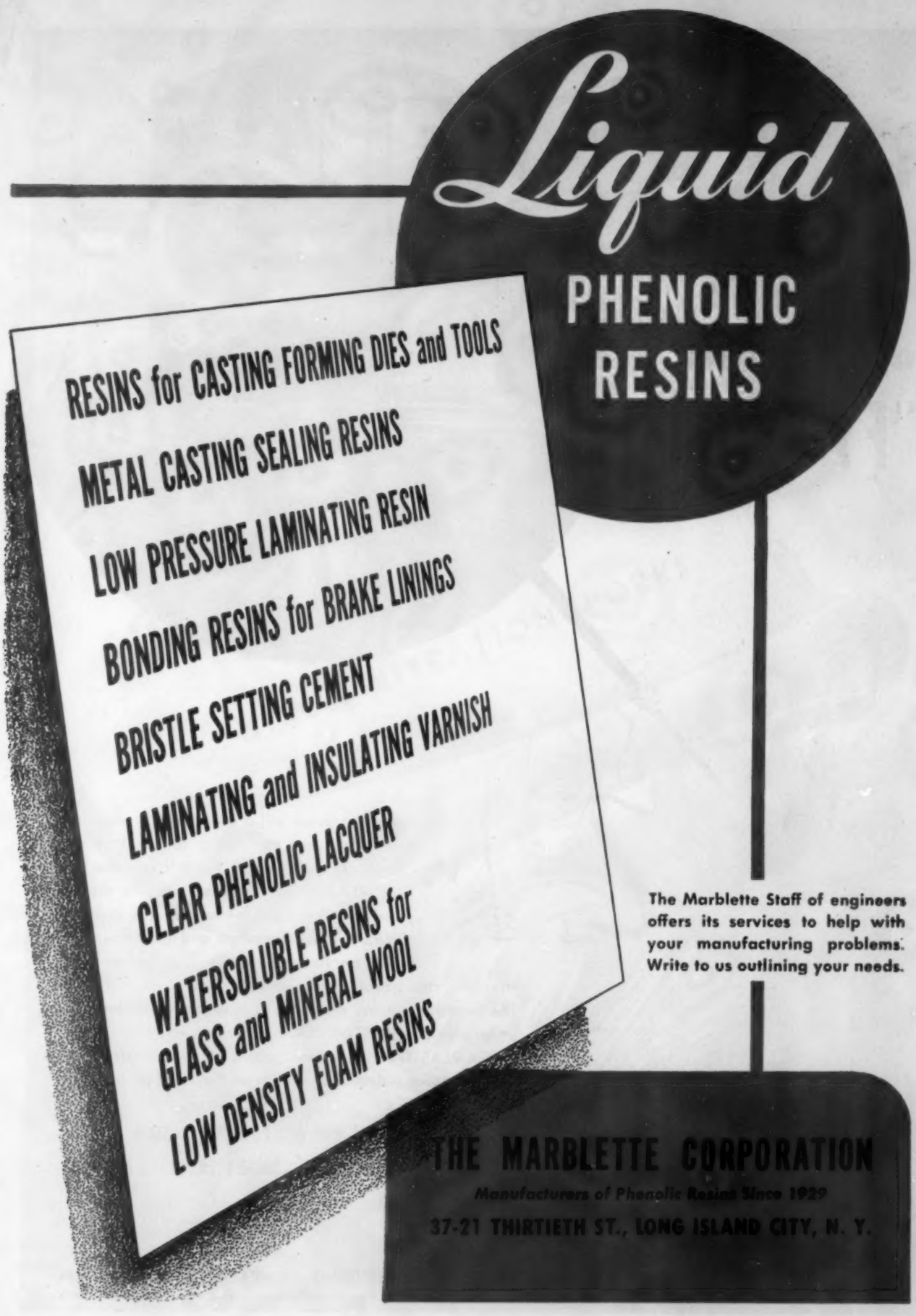
"YOUR PLASTICS DEPARTMENT"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operation "FATIGUE"

At what point will a given plastic material tire and cease to resist a certain type of force exerted upon it? Ask this question of the PLASTIVERSAL testing machine shown above and you get the answer. The PLASTIVERSAL gives immediate and accurate readings on flexural, tensile and compressive strengths, stress-strain curves and the moduli of elasticity. The material in every molded part produced at Watertown undergoes the PLASTIVERSAL'S searching scrutiny. Testing on the PLASTIVERSAL is only one of the many steps we take to assure satisfactory service of the finished product.

SEE HOW OUR COMPLETE CUSTOM MOLDING SERVICE WILL SOLVE YOUR PLASTIC PROBLEMS

Watertown

A NAME AS OLD AS THE PLASTICS INDUSTRY

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BRANCH OFFICE—Cleveland • SALES OFFICES—New York, Chicago, Detroit, Milwaukee and Hawaii.

Merry Christmas
and
Happy New Year
NIXON NITRATION WORKS

WORLD'S LARGEST PRODUCER OF SYNTHETIC RESINS

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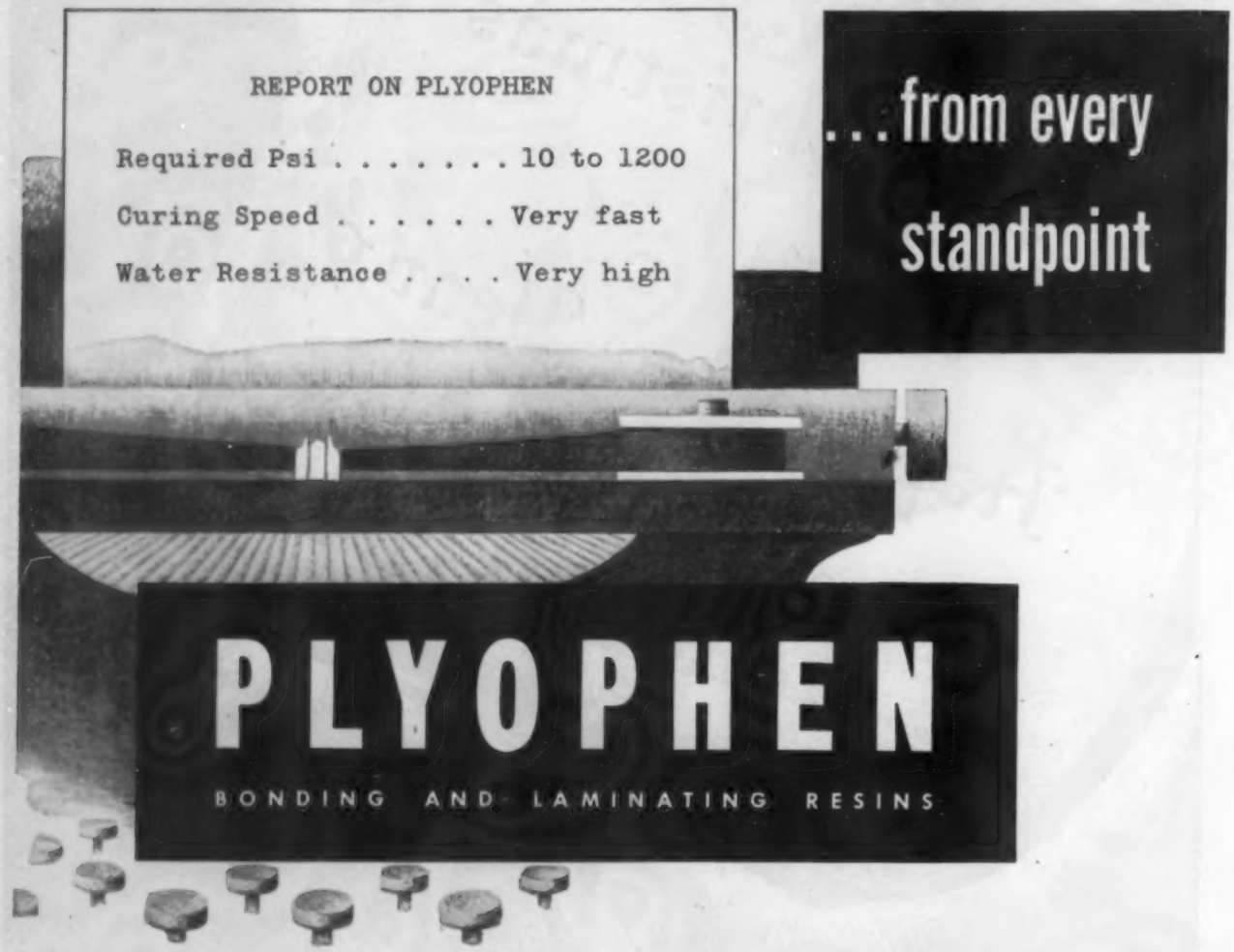
STANDOUTS...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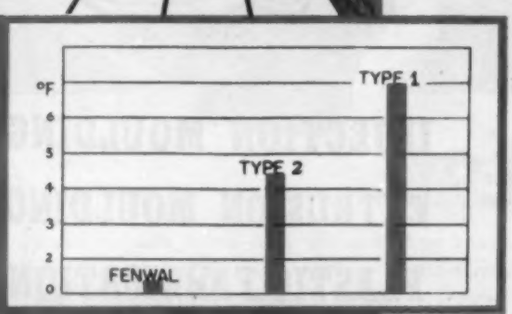
RUGGED DESIGN*

Efficient temperature detection and control practice calls for durability as well as sensitivity in the controlling instrument. The unique design of the Fenwal THERMOSWITCH Control embodies both great physical ruggedness and desirable performance characteristics. The Fenwal design provides double protection against abuse and mechanical shock — the extremely light and stiff bridge structure of the internal electrical assembly and the exceptionally strong outer shell. The patented structure of the internal assembly enables it to function in any position in spite of vibration and shock; the temperature sensitive outer shell is a cylindrical brass or stainless steel tube. This shell, normally 1/32" thick, can be furnished in greater thicknesses for special applications. Additional ruggedness is afforded the THERMOSWITCH Control by selection of the model with mounting facilities best suited to the particular application. Chart shows the small change in the THERMOSWITCH Control set point, compared to the change in setting of two other thermostats under similar conditions, when the unit is subjected to a mechanical shock of 100G.



CHANGE IN CALIBRATION DUE TO 100G SHOCK

The Fenwal THERMOSWITCH Control stands out in the field of heat detection and regulation. Inherent in its unique design are many advantages that make it ideal for most applications that call for temperature regulation. Learn about these advantages. *Send for a copy of the Thermotechnics Booklet which explains the "Fourteen Facts in Fenwal's Favor".*

COUPLING HEAD THERMOSWITCH CONTROL

FOURTEEN FACTS IN FENWAL'S FAVOR

1.—Fast reaction time
2.—Large heat sensitive area, small heat storage
3.—Short heat transfer path
4.—Small temperature differential
5.—Built-in temperature anticipation
6.—Enclosed assembly
7.—Minimal vibration effects
8.—Tamper-proof and sealed
9.—Rugged construction
10.—Adjustable over wide temperature range
11.—Minimum size
12.—Directly responsive to radiant heat
13.—Uniform sensitivity over adjustable temperature range
14.—Readily installed

*#9 of the "Fourteen Facts in Fenwal's Favor".

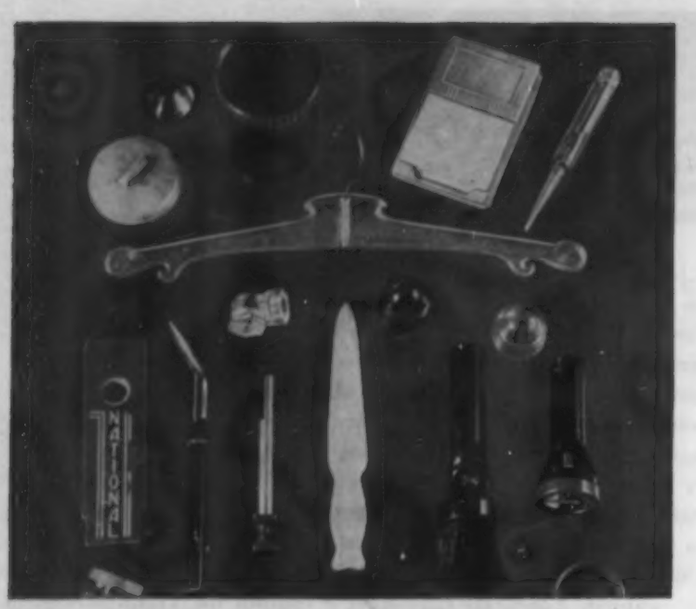
Fenwal

FENWAL INCORPORATED

35 PLEASANT STREET

ASHLAND MASSACHUSETTS

Thermotechnics for Complete Temperature Regulation



Plastic Parts
OF EVERY DESCRIPTION

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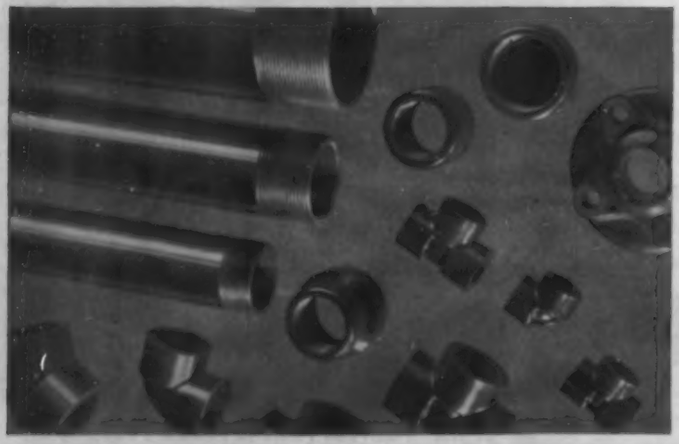
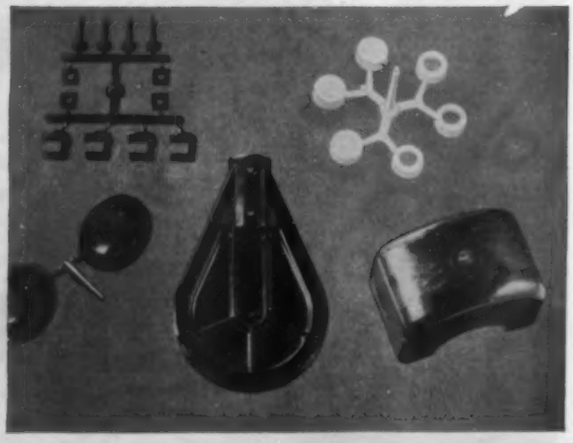


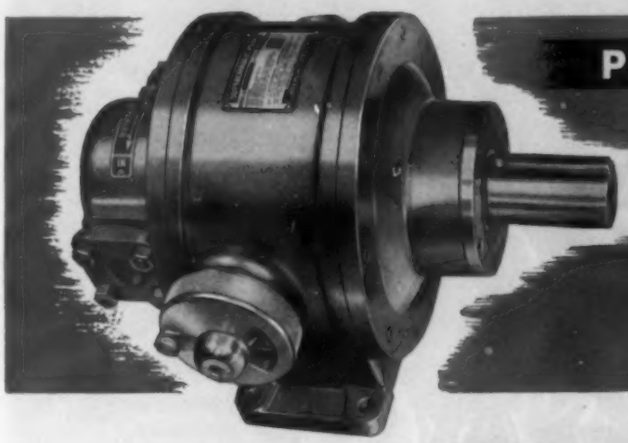


ST. LOUIS PLASTIC MOULDING CO.
SAINT LOUIS 8, MISSOURI

Every One a Star!

Superdraulic

Superdraulic pumps, motors, transmissions, relief valves, check valves, 4-way valves, power units, and high-pressure couplings enable you to utilize hydraulics at its best. Following are descriptions of principal Superdraulic units:

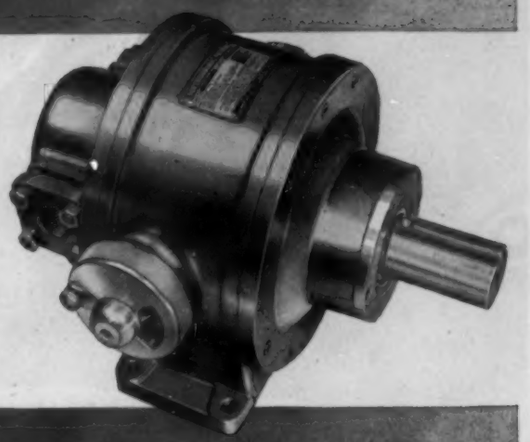


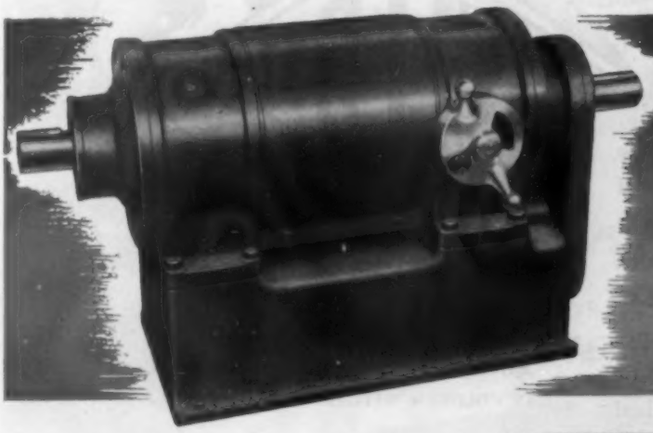
PUMPS

High-pressure hydraulic pumps—5000 psi, 40 hp with 0 to 12 gpm at 1200 rpm or 0 to 17 gpm at 3500 psi. Here is giant power in a midget hydraulic pump only 10½" in diameter. Instantly responsive finger volume control gives variable volume and reversible flow. Also available in constant delivery types only 9" in diameter with identical rating. Ideal power for presses, plastics machinery—wherever hydraulic power is required and where space is at a premium.

MOTORS

Triport hydraulic motors—26½ gpm at 3500 psi input at 1200 rpm, 19 gpm at 5000 psi input at 1200 rpm. Giant horsepower and giant torque in hydraulic motors of midget size. Sixty-six power strokes per revolution provide high starting torque and turbine-smooth output. Up to 47 hp with torque range up to 200 lbs. ft. in either type. Ideal for driving all types of machinery.



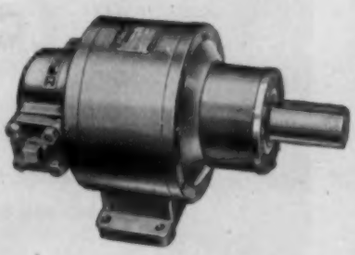


TRANSMISSIONS

Million-speed hydraulic transmissions. Combining the famous Superdraulic variable delivery pump and triport motor, these units provide infinitely variable, turbine-smooth power in minimum space. Up to 200 lbs. ft. output torque, 0 to 1200 rpm (reversible), up to 30 hp output. A perfect transmission for countless industrial applications.

JUNIOR PUMPS

The Superdraulic Junior Pump, as its name implies, is practically a duplicate of the 40 hp Superdraulic constant delivery pump on a reduced scale. A single bank of eleven plungers delivers 3 gpm at 1800 rpm and 2 gpm at 1200 rpm. This pump is furnished for 5000 psi continuous duty operation.



It is almost certain that in their long experience, Superdraulic engineers have been called upon to solve hydraulics problems similar to yours. They would welcome an opportunity to sit down with you and discuss the application of hydraulic power to your products.

In the meantime, send for complete technical descriptions of the above Superdraulic units.

Superdraulic Corporation

HYDRAULIC PUMPS • MOTORS • TRANSMISSIONS • VALVES

MILLER AT FORD ROAD • DEARBORN, MICHIGAN

Speaking of PRACTICAL EXPERIENCE...

WITCO

THESE sturdy, worn leather gloves tell the down-to-earth story of a workman "worthy of his hire." Likewise, the WITCO Trade-mark speaks more authoritatively than words about the invaluable *know-how* gained by WITCO through a quarter of a century of practical experience . . . know-how that enables WITCO's management, research, production and technical staffs to serve industry-around-the-world, dependably and with uniformly high quality products.

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Manufacturers and Exporters

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SAN FRANCISCO • AKRON • LONDON AND MANCHESTER, ENGLAND

PLYON'S in Production!

It's finally happened. After months and months of careful testing to insure its fitness to bear our name and our guarantee, Plyon is now in the works.

Although the applications of Plyon are virtually unlimited, we decided first to produce two items for which Plyon is the perfect material. They are:

TABLE MATS AND TABLE TOP MATERIALS

Plyon table mats are fashioned of paper with a flexible resin, incorporating a standard decorative design on both sides of the mat.

Plyon table top material, also using paper, employs the basic design currently used by high pressure laminates.. Aluminum foil is incorporated for cigarette proofing while the alcohol-resistant laminate is built up to 1/16" gauge in thickness.

Both Plyon table mats and table top materials are waterproof, impervious to most acids, long wearing, colorful and good to look at.

In addition, the same kind of Plyon, made more flexible, may be used for counter fronts, bars, etc., where the material must be bonded to a curved surface.

If these applications of Plyon fit into your picture we'd like to hear from you. In turn, we'll send you samples and quote you prices. Or if you have a particular application of Plyon you'd like to discuss, we'll be glad to talk it over with you.

Swedlow PLASTICS CO.

(CREATORS OF PLYON)

5527-33 District Blvd. • Los Angeles 22, Calif.

Prevent Wear & Tear under heavy duty thrust loads!..Where service conditions demand the best...Rollway Thrust Bearings stand up!

ROLLWAY *precision type* Roller Thrust Bearings,

the Leader in HEAVY DUTY THRUST UNITS

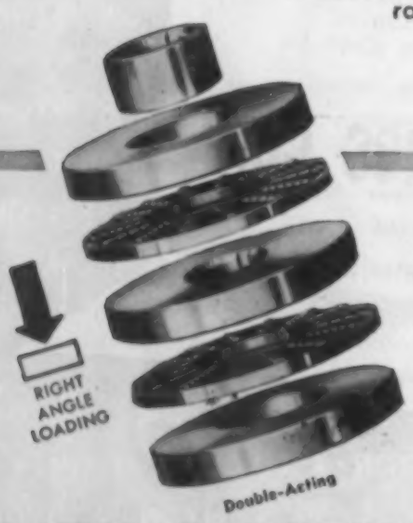
Single-Acting

HERE'S WHY!

1 ROLLWAY carries all loads at right angles to the roller axes.

Single-Acting Aligning

2 ROLLWAY solid-cylindrical rollers — staggered in position and varied in length, so as to cancel out "tracking" — are accurately spaced in machined-bronze retainers.



Double-Acting

3 Thrust plates, held to extremely close limits of parallelism, afford a linear contact with the straight cylindrical rollers, doing away with Brinell effect and roller "pinch outs" with consequent roller-end wear and rubbing friction.

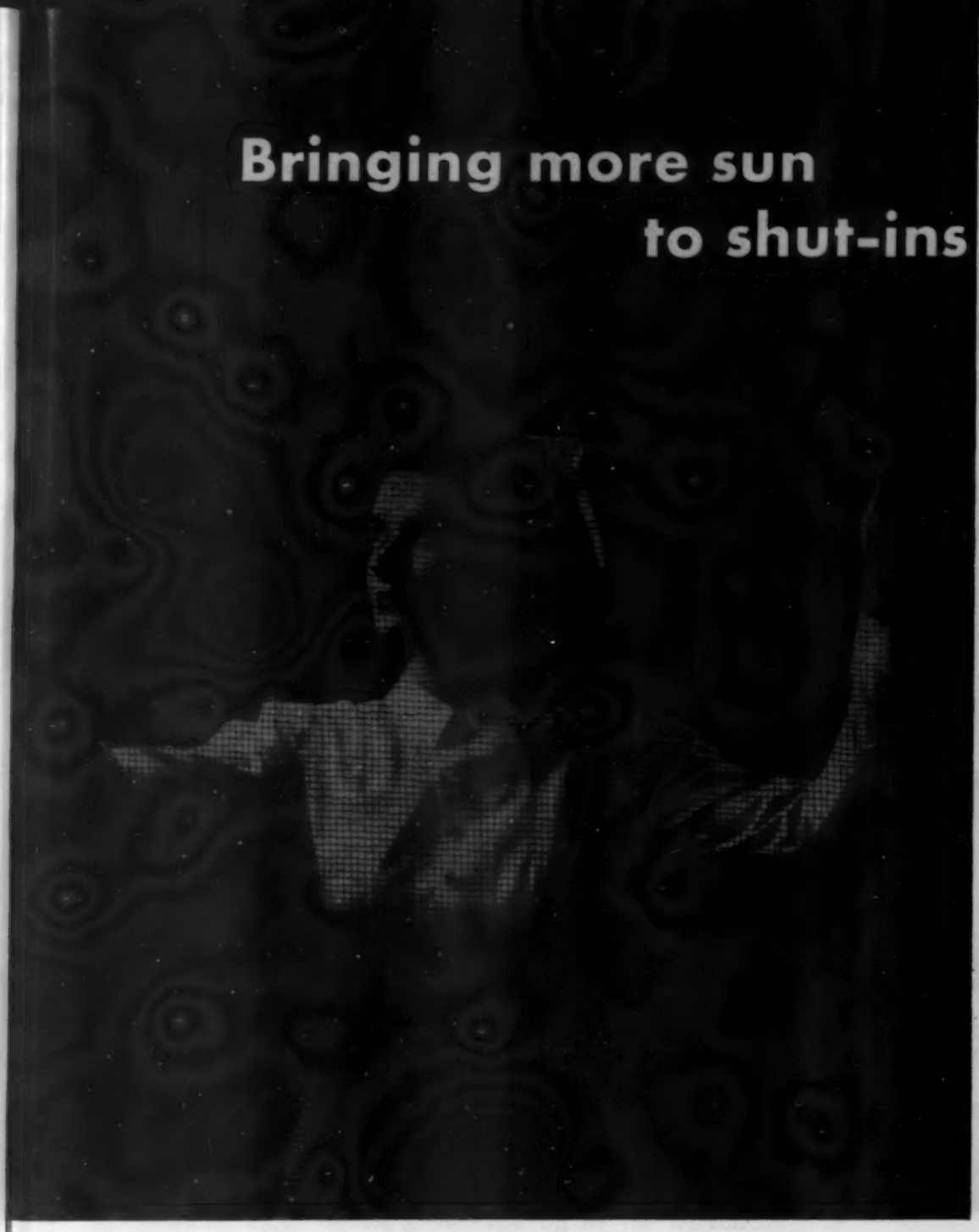
Six basic types in many sizes to choose from. Send a print or detailed description for free bearing recommendation.

ROLLWAY BEARING COMPANY, Inc., Syracuse 4, N. Y.

ROLLWAY CYLINDRICAL ROLLER BEARINGS

SALES OFFICES: Philadelphia • Boston • Pittsburgh • Youngstown • Cleveland • Detroit • Chicago • St. Paul • Houston • Los Angeles

Bringing more sun to shut-ins . . .



HARD to believe that the young nurse is adjusting a window glazed with a *packaging material*, isn't it?

Yet that's just what she's doing . . . Double layers of Kodapak II, thin-gauge, acetate butyrate sheeting, laminated with coarse-mesh cotton scrim, produce a lightweight, long-lasting, weather-resistant type of material that transmits a wide range of the sun's health-giving ultraviolet rays.

Result: a glazing specially adapted for use in hospitals, in homes and offices, and on farms.

Choice of Kodapak II for this purpose is proof again of this product's great versatility . . . of the wide range and variety of its uses.

Although the current supply of Kodapak and Eastman Acetate Sheet is not sufficient to meet the steadily increasing demand, the Kodak Transparent Packaging Laboratory in Rochester is available to demonstrate fabricating methods.

Cellulose Products Division
Eastman Kodak Company, Rochester 4, N. Y.

KODAPAK AND EASTMAN ACETATE SHEET

Attract . . . Protect . . . Sell

Kodak

When this Bell Laboratories chemist turns the stop-cock he raises a column of mercury to trap a micro-sample of gas evolved from a specimen of copper. Later he will analyze the sample by micro-techniques.

Trapping poisons by micro-chemistry

Touch of a finger-tip—or even the dust in apparently clean air—can carry enough contamination to ruin an electron tube. Bell System scientists found this out through micro-gas analysis using new and original techniques.

They determined what could destroy the tube cathode's power to give off electrons, and how much—to the millionth of a gram. Then, with Western Electric, they developed a manufacturing technique to keep these destroyers out of the tubes. . . . Bell Telephone Laboratories scientists established the world's first industrial micro-chemical laboratory more than 16 years ago for the Bell System.

Today micro-chemistry is constantly at work, helping to raise still higher the standards of telephone service and performance.

BELL TELEPHONE LABORATORIES

EXPLORING, INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

DoALL "Backed Up" SAWING SERVICE

At your call—200 factory-trained engineers in 38 coast-to-coast Service Stations—one specifically assigned to you! These men don't stop with advice. They are working engineers who help you determine the correct cutting speed, saw pitch, temper, set, width, feeding pressure, etc., so important in machining today's many different materials.

This "on-the-spot" service is *backed up* by the DoALL Research Laboratories — largest of their kind. Here special tests that are beyond field facilities are made for you without charge. Here you get the last word in technical "know-how" on sawing because of day-to-day information on all modern materials developed by leading industries everywhere.

Don't hesitate to write for DoALL assistance.

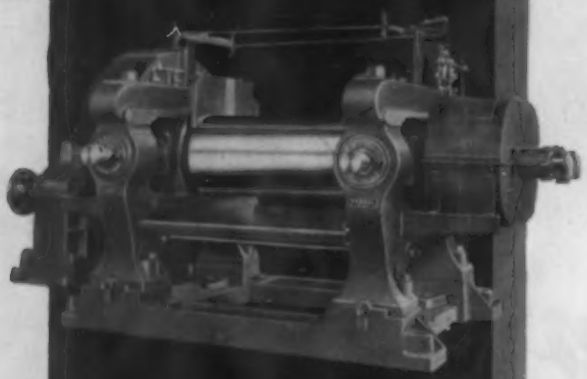
- **200 FACTORY-TRAINED ENGINEERS**
- **38 COAST-TO-COAST SERVICE STATIONS**
- **DoALL RESEARCH LABORATORIES**

The DoALL Company

DoALL STORES IN PRINCIPAL CITIES

SMALL TOOL DIVISION DES PLAINES, ILLINOIS

WHY THIS MILL HAS A PART IN SYNCHRONIZED PROCESSING



This 22" x 60" mill is built to fit into a Farrel-Birmingham "matched production unit," designed for continuous and efficient processing of plastic stocks in the manufacture of supported and unsupported film.

It is capable of handling the 1200-pound per hour output of a 3A Banbury mixer, and can be depended upon to provide a regular supply of properly conditioned material to a 24" x 66" calender.

By design and construction this mill is adequately prepared for its integral part in this important production set-up. Here are some of the details:

The rolls are hard chilled iron, chamber-bored to provide uniform heating, and fitted with special stuffing boxes designed for high temperature.

The rolls are carried in full-bronze-lined, water-cooled journal boxes, lubricated by continuous circulating system. The lubricant is pumped from a sump in the mill foundation in which there is a cooling coil and strainer. Special oil seals at both ends of the journal boxes retain the lubricant and keep oil from the roll faces, and stock out of the boxes.

Guides are automatically self-adjusting with the adjustment of the front roll. Cut spur gears are enclosed in sheet steel guards and run in oil bath.

OPTIONAL EQUIPMENT

Chrome-plated rolls; non-corroding guides and mill pan; a ratchet-operated mechanism for raising guides to facilitate thorough cleaning; motor-operated roll adjustment, and vernier dials on the adjusting screws can be provided when required.

Farrel-Birmingham will build a roll mill or a complete processing unit to fit your production requirements. Write for information on roll mills, or, if you want to know more about the matched production unit, ask for new bulletin No. 183.

FB-354

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.

Plants: Ansonia, Derby and Stonington, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, Stonington, New York, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston, Charlotte

Farrel-Birmingham

The standard Matched Production Unit for processing plastics consists of a size 3A Banbury mixer, a 22" x 60" mill, and a 24" x 66" four-roll calender.

The wind-up, let-off and cooling equipment provide for the production of film, heavier gauge sheet, or coated fabrics.

A BRIGHT SPOT ON A RAINY DAY

Let it rain, here's a saltshaker that won't clog no matter how damp it gets. When shaken like any ordinary saltcellar, the salt is thrown against the dome top which deflects it down through a tube and out of the bottom. A trouble and temper saver if there ever was one.

The use of plastics in this moisture proof salt and pepper shaker is just another case where plastics have added a sales advantage to a common, ordinary product. Ingenious in its simplicity, the snug fit of the smooth plastic shaker bases against the polished stand effectively seals the contents from humidity.

The broad scope of our 30 years of plastics experience, using all molding methods and materials, enabled us to find the best solution to this manufacturer's problem. Write for your copy of our 16 page booklet which will help you improve *your* product by the use of plastics.

Aico

PRECISION MOLDING

AMERICAN INSULATOR CORPORATION
NEW FREEDOM, PENNSYLVANIA

SALES OFFICES—Cleveland, Detroit, New York, Philadelphia

MANY THINGS ARE BETTER BECAUSE OF PLASTICS

● A 16 ounce LESTER Injection Molding Machine—one of a battery in operation at the Injection Molding Company's Kansas City plant.

● Commenting on LESTERS, President W. K. Archer writes, "... At the present time we have three LESTER molding machines in operation. The small 4 ounce machine has been in operation continuously since 1938 and is still going strong. This-in itself needs no further recommendation..."

The fine products indicate the fine caliber of work turned out in this plant.

● *Write today* for detailed information on the new LESTERS.

INJECTION MOLDING MACHINES

Distributed by **LESTER-PHOENIX, INC.**

2621 CHURCH AVE., CLEVELAND 13, OHIO

Extruders and Molders of all Thermoplastic Materials

Give Us Your Problems

YARDLEY *Plastics Co.*

142 PARSONS AVE. COLUMBUS 15, OHIO

Extruders of SARAN, CELLULOSE ACETATE, BUTYRATE, POLYSTYRENE, STYRALLOY and VINYLS. Also Injection and Compression Molding

Measuring Mold Shrinkage

Peakes Rossi Flow Tests

High Frequency Preheating

TRAINING *in step with* INDUSTRIAL TRENDS

Plastics Institute training is predicated upon two basic principles:

A. Thorough study of accepted practices and materials.

B. Evaluation of current problems, new materials and new techniques.

THREE TYPICAL PHASES OF MOLDING TRAINING

Mold Shrinkage and After-Shrinkage Experienced plastics molders realize that there are still many problems to be solved in estimating shrinkage characteristics. Plastics Institute students explore such variables as pre-conditioning of molded parts, humidity, temperature, mold dimensions, etc.

Predetermination of Flow Plastics Institute students learn to evaluate the flow characteristics of molding compounds by orifice flow tests and Peakes Rossi flow analyzers, and how to translate this data into a production cycle. What effect humidity, pressure, high frequency preheating, storage, have on flow are typical student projects.

High Frequency Preheating High frequency preheating has resulted in a remarkable gain in plastics molding production speed and quality. Plastics Institute students study such variables as time of heating, power impact, rate of load application, and the time interval of applying load after removal from press.

In addition to molding, other phases of plastics thoroughly covered at Plastics Institute include: Materials, casting, mold design, fabricating and laminating. Industry type equipment is used in the classrooms.

Your inquiries regarding the Resident, Home Training and Study Forum Courses are welcomed.

VETERANS as well as CIVILIANS now training with Plastics Institute, upon graduation, are qualified and worthy of your consideration for employment in the various branches of the plastics industry. Write to the nearest branch of Plastics Institute stating your requirements. We will endeavor to select a graduate best qualified to meet your needs.

Write Dept. MP6-12

Plastics
INDUSTRIES TECHNICAL INSTITUTE

Francis A. Gudger, President - John Delmonte, Technical Director

NEW YORK- 122 East 42nd St. ★ CHICAGO 3810 N. Broadway ★ LOS ANGELES- 1601 Southwestern Ave.

AMOS *did it...* RIGHT!

Transparent, molded escutcheon-plate above is lacquer-coated on back to produce a beautiful, mar-proof, silver-like finish. Finished assembly at left.

It's an escutcheon for the cold control on a well-known refrigerator. Amos molded it of clear polystyrene, for transparency, dimensional stability, and resistance to moisture. It is shaped to fit perfectly all curving contours in the throat-lining.

Spray-coating the back of the transparent plate with a special aluminum lacquer produced a permanent silver-like finish, impossible to scratch or mar. Thus, Amos delivered a molded plastic escutcheon-plate superior in beauty and in utility. In every respect Amos did the job *right!*

Every step of every Amos molding job, from designing to finishing, is handled by experienced specialists in plastics engineering. For injection molded parts and products that excel in design, accuracy of molding, and quality of finishing, just send your drawings or write us what you have in mind. Amos will *do it right!*

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA
Division of Amos-Thompson Corporation
One of the Most Modern Plastic Molding Plants in the Industry

Telling the World it's a REMINGTON

with

MEYERCORD DECALS

THE MODERN NAMEPLATE USED ON THOUSANDS OF PRODUCTS

Meyercord Decalcomania is a durable, flexible material that can be quickly applied to practically any commercial surface . . . at production line speeds. No rivets or screws. No sharp corners or edges. Simple, easy-to-use methods assure smooth, legible. lasting adhesion.

Nameplates, trademarks, operating instructions, lubrication guides, patent data and scores of other nomenclature can be reproduced in any number of colors, sizes or designs. Meyercord Decals are washable, resistant to acids, moisture, abrasion, vibration and hard use. They can be applied to concave, convex or flat surfaces with equal success.

Investigate Meyercord Decals, the modern stream-lined method of product identification used by manufacturers to save time and material cost.

Send for free MEYERCORD DECAL SELECTOR. Tells how and where to use Decals. Firm letterheads, please. Address Dept. 21-12

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• DECORATE
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your products with
MEYERCORD DECALS

THE MEYERCORD CO.

World's Largest Decalcomania Manufacturer

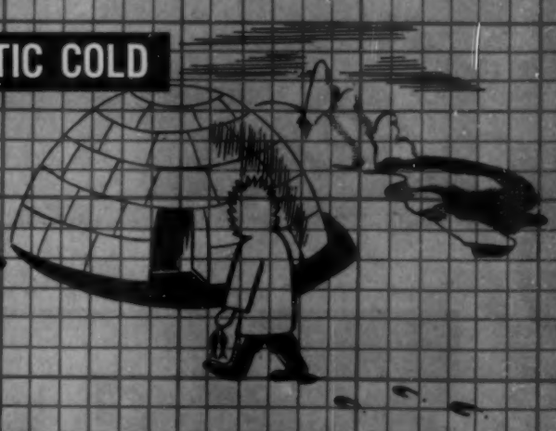
5323 WEST LAKE STREET • • • CHICAGO 44, ILLINOIS

BAKER *plasticizers*

from TROPIC HEAT

are unexcelled for retained FLEXIBILITY

to ARCTIC COLD



The BAKER CASTOR OIL COMPANY *Established 1857*

120 Broadway, New York, N. Y. • Chicago, Illinois • Los Angeles, California

Santay

SYMBOL OF PRECISION CRAFTSMANSHIP

PARTS APPROVED

•

NO FURTHER SAMPLES REQUIRED

WELCOME words to the customer as well as the molder. Injection molding by Santay has reached a degree of perfection —sought by many—reached by few. We are particularly proud of our outstanding record of first trial parts approved for production. This record of achievement is not mere chance. It is the result of painstaking attention to detail.

You may have an idea or problem that is shelved because it strays from the accepted pattern. Consider for instance the Philco dial scale illustrated here. Molded in a two cavity mold of clear polystyrene, the engraved calibrations and lines .040 deep, are formed over a complete 90 degree arc. The face of the dial is on a 4½ inch radius. "Impossible to strip from the mold", you might say . . but our engineers found a way. Such ideas or problems are welcome here. Let us show you the way our "KNOW HOW" can lead to superior injection molded parts.

INJECTION MOLDING AND METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

SANTAY CORPORATION, 355 NORTH CRAWFORD AVE., CHICAGO 24, ILLINOIS

REPRESENTATIVES: POTTER & DUGAN, INC., 29 WILKESON STREET, BUFFALO 2, NEW YORK • PAUL SEILER, 7779 CORTLAND AVENUE, DETROIT 4, MICHIGAN • QUEISSER BROS., 110 E. NINTH STREET, INDIANAPOLIS 2, INDIANA

Chemaco MOLDING POWDERS for MASS PRODUCTION

IN THE NEW NOMA BUBBLE-LITE

ONE of the most ingenious postwar developments in Christmas tree decoration is the Noma Bubble-Lite with its illuminated two-tone translucent base of Chemaco Cellulose Acetate in brilliant colors.

Only a plastic is able to meet all the requirements of this particular job. The base, for instance, must be light and thin-walled although resistant to impact. Because it must house the bulb, it must be resistant to heat transfer. For clear color without glare the finish must be slightly translucent. And for permanence the color must be inherent in the material. Dimensional stability is also essential to assure perfect matching of the halves in assembly.

Chemaco Cellulose Acetate and Chemaco Technical Service combined to produce a formulation that answered all these needs and in addition provided fast, clean molding as well as a greater number of pieces per pound.

In Noma Bubble-Lites, Chemaco Cellulose Acetate once more demonstrates its amazing versatility . . . a versatility that makes it applicable to many, many products — perhaps one of yours! Why not find out?

Chemaco Corporation

A subsidiary of Manufacturers Chemical Corporation

Berkeley Heights, N. J.

Branch office in Cleveland

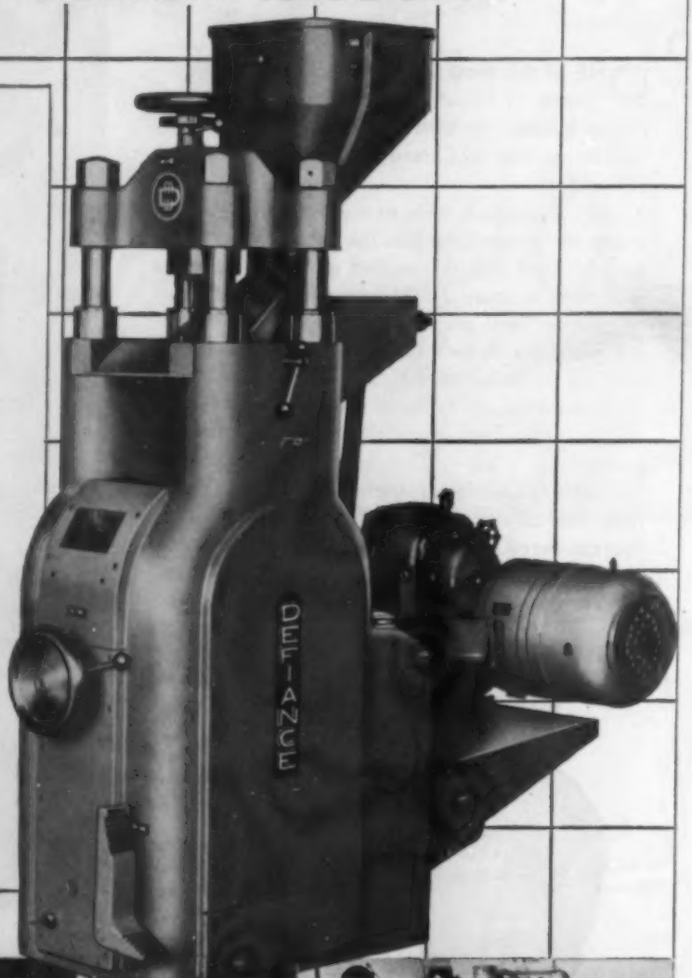
CELLULOSE ACETATE • ETHYL CELLULOSE • POLYSTYRENE

PRODUCTION UP with LESS DOWN-TIME and FEWER REJECTS!

This highly versatile new Defiance Plastic Preform Press solves a wide range of preform problems—for many shapes and sizes. It does the job *faster*... with *greater accuracy*... and *lower costs!*

Built for high-speed production—with advanced Defiance features *designed by plastics engineers for the plastics industry.* Die and color changes in 30 minutes—not 4 or 5 hours. Also, you can adjust density and fill while machine operates. Assures high uniformity of weight and density—with fewer rejects, small flash, less handling and filing. Easy to clean. Precision-built for utmost dependability. Write for latest bulletins. Defiance Machine Works, Inc., Defiance, Ohio.

NEW DEFIANCE PLASTIC PREFORM PRESS

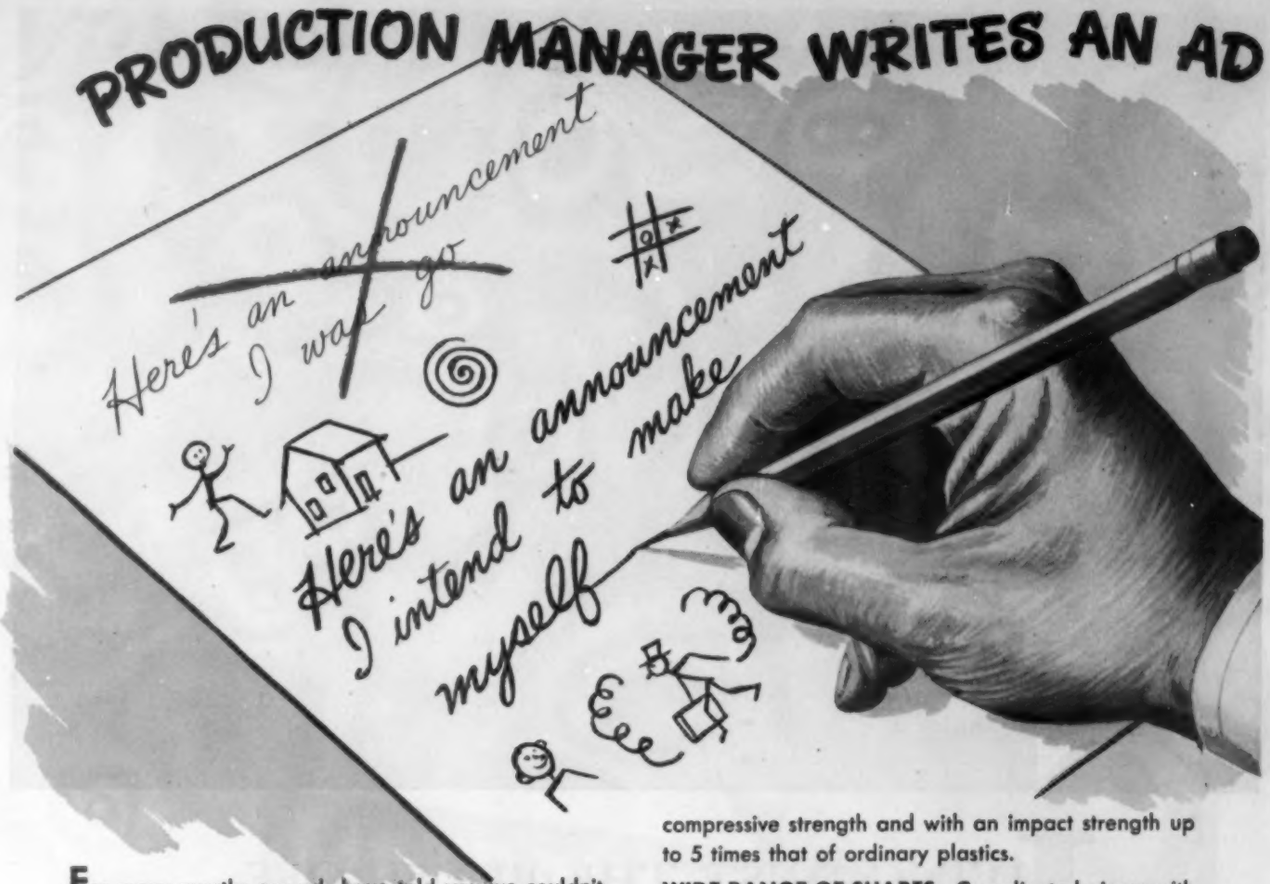


Modern Defiance Plant—where accuracy is the watchword throughout operations.

In assembling Defiance Plastic Presses—experienced engineers keep a watchful eye on precision.

Laboratory testing plays an important part in Defiance production.

PRODUCTION MANAGER WRITES AN AD



For many months our ads have told you we couldn't handle new specialty orders. For many months I've struggled against manpower, equipment and material shortages for the day when I could report a change in this policy.

That day has arrived! I'm happy to announce at last that KEYES FIBRE COMPANY is accepting new specialty business again, scheduling production as orders arrive. We custom mold to specifications, deliver units complete, ready for use. Write us about your molding problems—the tougher they are, the better we like 'em.

And here's a reminder list of KYS-ITE's unique advantages—a list to remember when plans reach specifications stage.

GREAT STRENGTH WITH LIGHT WEIGHT—Preformed before curing, an even distribution of phenolic resin on interlocking fibres results in great tensile and compressive strength and with an impact strength up to 5 times that of ordinary plastics.

WIDE RANGE OF SHAPES—Complicated pieces with projections and depressions, large or small shapes and sections—all these and more, too, are molded successfully in KYS-ITE.

***KYS-ITE* CAN "TAKE IT"**—Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

INTEGRAL COLOR—KYS-ITE's lustrous finish is highly durable; the color is an integral part of the material itself. A wipe and it's bright!

NON-CONDUCTOR—KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

KEYES FIBRE COMPANY
420 Lexington Avenue
New York 17, New York
Plant at Waterville, Maine

KEYES
MOLDED PRODUCTS

KYS-ITE articles indicating the range of items we mold to specifications and deliver complete, ready for use.

KYS-ITE

Preformed Plastic Combining Long-Fibered Wood Pulp and Synthetic Resin

Trade Mark Reg. U. S. Pat. Off.

GIVING DUST THE BRUSH-OFF

Result: . . . better working conditions

Heat and dust from top charging furnaces are drawn off at source, instead of being disseminated throughout the steel foundry of the Chapman Valve Manufacturing Company at Indian Orchard, Massachusetts.

The complete plant . . . offices, health clinic, laboratory and production facilities . . . was designed and built by Stone & Webster Engineering Corporation in 11 months from date of authorization.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

WHEREVER PLASTICS ARE PREHEATED...

AIRTRONICS*

means

Engineering Leadership!

From AIRTRONICS' laboratories has come a steady stream of advancements in preheater design inspired by *and fulfilling* the practical requirements and preferences of the molding industry. Dual Load Selection, Automatic Power Regulation, Automatic Load Accommodation, Automatic Excitation Regulation, powerful Vacuum Cooling—all these features plus extreme compactness and mobility, simplicity of adjustment and operation, versatility of application and *reliability* of service make AIRTRONICS Dual Preheaters the choice of discriminating molders from coast to coast. Contact the nearest AIRTRONICS representative for complete details.

2.5 KW
Model DH

Airtronics MANUFACTURING CO.

*REG. U. S. PAT OFF.

National Sales and Service:

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Los Angeles 26, 4536 Cutter Street

This booklet belongs on the desk of every designer, engineer, production chief and purchasing agent in plastics. Send for it.

PLASTICS THAT **GLOW** IN THE DARK . . . MEAN SALES THAT GROW IN THE DAY!

VIOLITE*

LUMINESCENT PHOSPHORESCENT FLUORESCENT PIGMENTS

Plastic products that *glow in the dark* have tremendous sales appeal. This has been proved time and again with dials, knobs, signs, markers, wall-plates, tools, radios, toys, novelties, etc. There may be many items you are now manufacturing, or planning to manufacture, that will benefit by this simple improvement. And it *is* simple! Merely specify the addition of VIOLITE Phosphorescent or Fluorescent Pigments when ordering your plastic molding powders. If you are not completely familiar with the many possibilities offered by VIOLITE send for this free booklet today.

WHEN ORDERING MOLDING POWDER

SPECIFY *VIOLITE*...

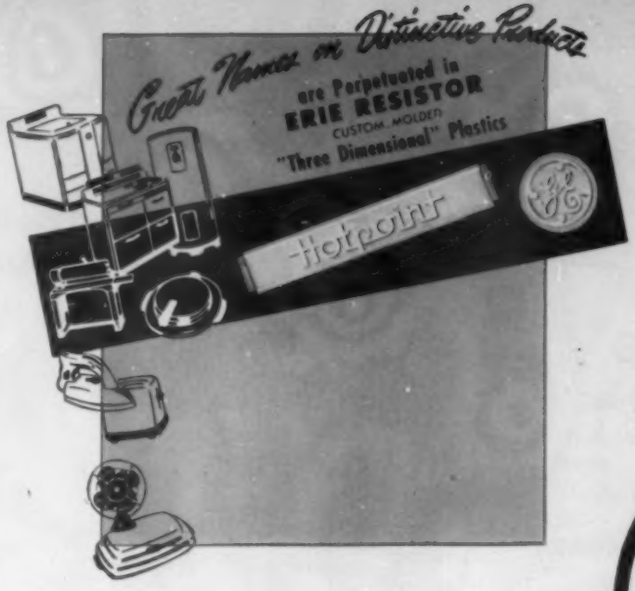
You need no extra equipment . . . your unit production cost is not appreciably increased . . . you need not alter your production methods . . . our technical experts will gladly advise you how VIOLITE can be used in your own products.

Sun CHEMICAL CORPORATION

VIOLITE
LUMINESCENT PIGMENTS
PHOSPHORESCENT • FLUORESCENT

RHODE ISLAND LABORATORIES, INC.
AN AFFILIATE OF SUN CHEMICAL CORP.
100 PULASKI STREET, WEST WARWICK, R. I.

Reg. U. S. Pat. Off.



A SYMBOL OF QUALITY

ERIE RESISTOR

Custom molded plastics

ERIE Resistor is prepared to take your product at any point in its development, and carry it through to finished form. You may have only a nebulous idea; you may have finished drawings; you may have a metal part which you would like to replace with plastic; you may have an expensive part, made by hand operation, which you would like to reproduce with the economy of automatic processes; you may have a product which answers all your requirements, except for strength, or insulating properties, or color appeal.

We have dealt with all these problems, and many others, and solved them to the enthusiastic satisfaction of our customers. Parts that made products more serviceable; designs that united beauty with utility; nameplates that made trademarks decorative spots of eye-catching appeal; containers that built sales and profits; there is a versatility in these accomplishments impossible without the most versatile of materials with which to work, but impossible also without the enthusiastic and cooperative skill of artists, engineers, and operators.

Think of your product in terms of possible improvement by the use of plastics; and, when you think of plastics, think of Erie Resistor custom molded plastics.

Plastics Division

ERIE RESISTOR CORP., ERIE, PA.

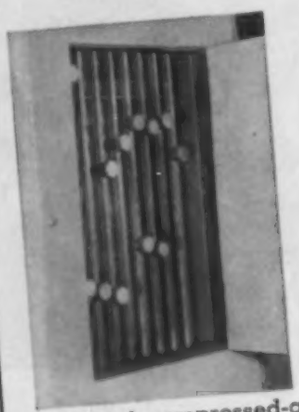
LONDON, ENGLAND • • TORONTO, CANADA

STOKES MOLDING IS *Really Automatic*

because

The Piece Operates the Press

The exclusive principle of having the piece operate the press means that Stokes Automatic Molding Machines are *completely* automatic. All moldings must pass through a sensitive trap. Should a piece fail to eject for any reason, should any irregularity in the molding cycle occur, this trap stops the machine and a warning bell automatically attracts the operator's attention.



OTHER FEATURES that mean 100% AUTOMATIC OPERATION

The Stokes Automatic Cycle Controller, easily reset to provide quick changeover from job to job, controls all functions of the machine—feeding, closing, breathing, curing, opening, ejection, mold cleaning. The powder measuring and feeding mechanism is micrometer-adjusted and automatically controlled. An automatic push-off combines mechanical and compressed-air action to eject pieces and clean the mold.

Stokes Model 235 50-Ton Automatic Molding Press. Covered by U. S. and foreign patents.

AUTOMATIC MOLDING is foolproof, flexible, economical

The above and other Stokes developments provide molding presses that are reliable, foolproof, economical. An unskilled man can run a battery of them. These machines are producing a wide variety of parts, in hundreds of shapes and sizes, for such diverse products as electrical, home and office appliances, radio and electrical equipment, automotive accessories, toys, novelties, many others.

Parts produced automatically are identical, low in flash loss, accurate in dimensions, of highest quality. Investigate Automatic Molding.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road, Philadelphia 20, Penna.

F.J.Stokes MOLDING EQUIPMENT FJS Est. 1895

Holy Water Fount
Molded for
Bristol-York Associates
Chicago

Reverence...in Plastics

In molding this holy water fount, we humbly endeavored to express in it a feeling of simple beauty—dignity—reverence. This embodiment of moods in plastic materials is further evidence of our "imagineering"* ability...an ability we feel sure can satisfy your most exacting demands in injection molding artistry and extrusion craftsmanship.

We apply equally painstaking care and skill to all types of molding assignments from the simple to the highly complex and in the desired mood, whatever it might be. Let us mold your product in the right mood for its most profitable use. We invite your inquiries without obligation.

*Imagination plus engineering skill

Write on your letterhead for the new Injection Molded and Extruded Plastics catalogue. Or, for detailed information about •MIMO-PLASTICS* pipe, tubing and fittings, write for circulars containing data and illustrations.

*Trademark Reg.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Plexiglas, Nylon, Polystyrene, Styron, Lustron, Loalin, Vinylite, Geon, Plexene, Polyethylene, Cerex, Forticel, •MIMO-PLASTICS*, Saran, and other Thermoplastic Materials

153 WEST HURON STREET • CHICAGO 10, ILLINOIS

Economy and Utility—

IN PLASTICS AND METALS

Distributor cap of plastics and metals, nipples of Elastomeric plastic, together with distributor and spark plug wires; all precision manufactured by Auto-Lite.

•

See our catalog in Sweet's File for Product Designers.

The range of products and parts where plastic and metals can be combined to decided advantage is growing rapidly . . . costs are cut . . . streamlined design becomes practical . . . color can be readily incorporated. For instance, this Auto-Lite distributor cap assures the highly important precision positioning of the metal contacts, provides a high insulation factor, gives low-cost construction . . . and even this utilitarian item shows the modern color eye appeal possible through plastics. The nipples are plastic, too, in a material which resists both ozone and oil in breakdown tests far surpassing any normal field conditions.

THE ELECTRIC AUTO-LITE COMPANY

Bay Manufacturing Division

Detroit 2, Michigan **Bay City, Michigan**

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COMMON SENSE ASSEMBLY ENGINEERING

SKIPS a needless operation SAVES a needless expense

By changing to P-K Screws, the C. J. Tagliabue Mfg. Co. avoided the risk of ruining plastic parts by misjudging depth when tapping blind holes for machine screws.

In this industrial measuring instrument, P-K Type "Z" Screws (A) attach steel clips; (B) fasten plastic rheostat disc; (C) attach steel clamps holding wire.

By using P-K Type "Z" and Type "U" Self-tapping Screws to replace machine screws and tapped holes as a means of securing contacts and clips to a Tenite battery case, E. A. Meyers and Sons report an increase of 30% production speed and a saving of 50% in assembly time and labor.

The fastening operations on these products threatened to be assembly bottlenecks until the P-K "short-cut" method was adopted. P-K Self-tapping Screws eliminated tapping . . . a tedious, job-slowing operation that frequently boosted costs further by high product spoilage and tap breakage.

P-K's "short-cut" fastening method offers more than one way to simplify assembly. Many manufacturers have used P-K Screws to eliminate the need for metal inserts. Often they permit better product design, stronger assemblies – and effect savings in time and labor that run as high as 50%.

It's plain common sense to take advantage of savings like these. In 7 out of every 10 assembly problems submitted, the P-K "short-cut" fastening method has eliminated needless operations and expense. Why not discuss your fastening methods with a P-K assembly engineer, or, send assembly details to us for recommendations. Parker-Kalon Corporation, 200 Varick St., New York 14, N. Y.

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PARKER-KALON SELF-TAPPING SCREWS

A FASTENING FOR EVERY METAL AND PLASTIC ASSEMBLY

THE entire mechanism—high pressure hydraulic pump, motor, relief valve, oil level gage and filter, 7½ gal. reservoir—all completely enclosed for maximum safety. All moving parts isolated from possible contact with clothing or hands and protected against damage.

Three types of units:

(1) 3 gallons per minute, 1,000 P.S.I. continuous operation
(2) 1¼ gallons per minute, 3,000 P.S.I. continuous operation
(3) ½ gallon per minute, 10,000 P.S.I. continuous operation

This compact hydraulic unit operates laboratory and production presses, roll balancing devices, hydrostatic testing equipment, hydraulic controls, machine tools, arbor presses, etc. Complete engineering information for any particular application available upon request.

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THE NEW Fibron #5373 FLEXIBLE PLASTIC TUBING

Test Data

Tensile Strength....3000 P.S.I.
Dielectric Strength (.020" wall) Wet.....1000 VPM
Dry.....1000 VPM
Life at 105° C.....2000 Hrs.
Chemical Resistance (room temperature)
50% Sulfuric Acid and
30% Sodium Hydroxide.....Unaffected
Does not support combustion
Low Temperature Flexibility
I.V.I. Pinch test.....—40°C.
Bell test.....—30°C.
Heat Endurance (.166" ID tubing, .016" wall) ASTM-D350-43T): 7 days @ 125°C.—No crack when bent 180° around ¼" mandrel—Retains flexibility when varnished and baked 22 hours at 260°F.—No flow or drip during 8 hours at 300°F.

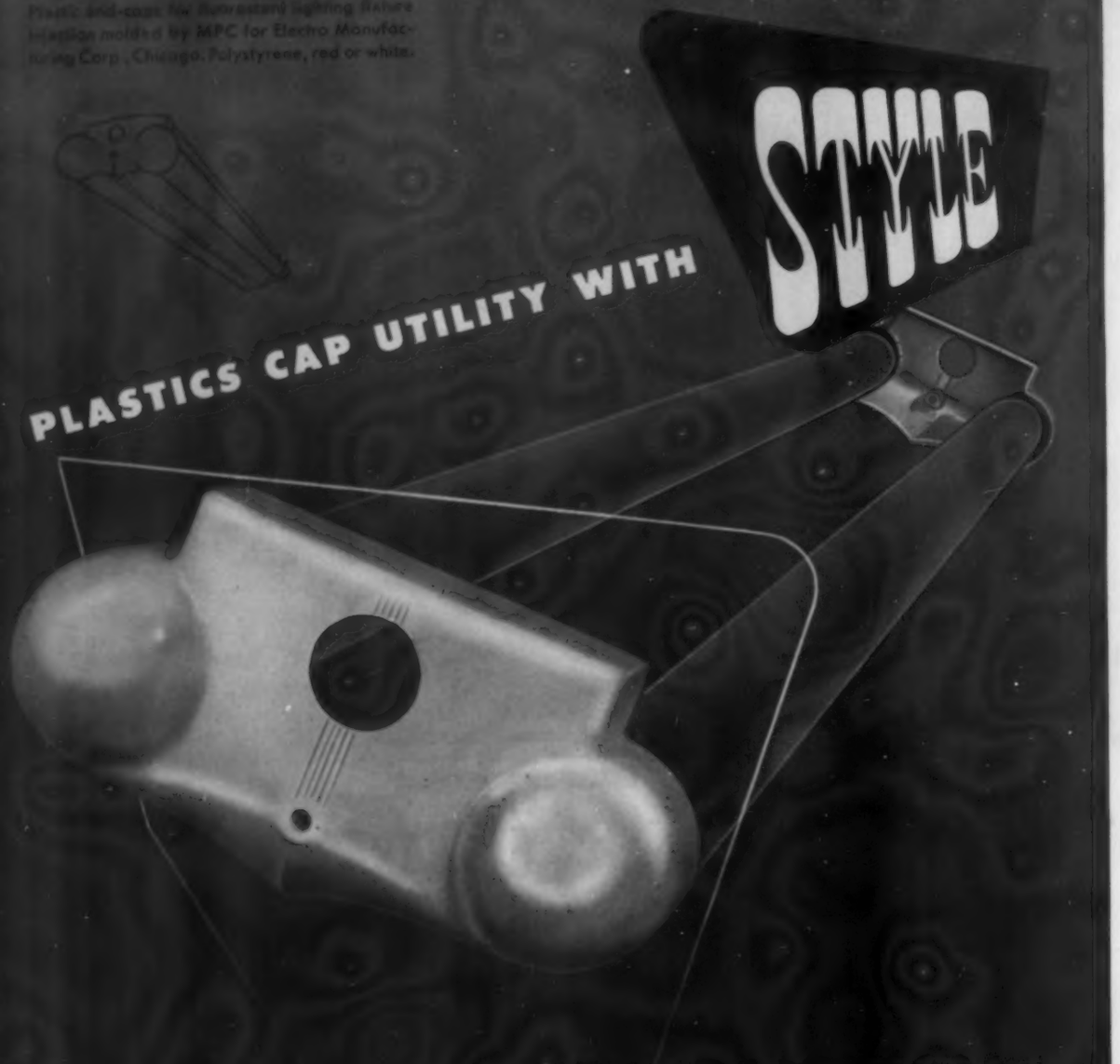
This Irvington formulation provides new advantages, new cost-saving features, for many plastic tubing applications. For example: Transformer leads of #5373 remain flexible even after varnishing and baking . . . Underwriters' Laboratories approved #5373 insulation on applications involving continuous operating temperatures up to 75 deg. C. and intermittent temperatures as high as 85 deg. C. In addition, #5373 possesses the excellent electrical, mechanical and chemical properties which distinguish all Fibron tubings.

Tubings of Fibron #5373 are available in all standard colors and sizes, and in heavy wall thicknesses—in 36" lengths, continuous coils, or cut pieces. For full details and generous samples, write Dept. 146 Irvington Varnish and Insulator Co., Irvington 11, New Jersey.

IRVINGTON *Varnish and Insulator Company*
IRVINGTON 11, NEW JERSEY, U.S.A.

Plastic end-caps for fluorescent lighting fixture injection molded by MPC for Electro Manufacturing Corp., Chicago. Polystyrene, red or white.

PLASTICS CAP UTILITY WITH STYLE



This sleek fluorescent fixture is a far cry from earlier crudely functional models. In designing the end-caps, the remarkable properties of plastics were ingeniously utilized. Those pleasing contours could be economically formed with plastics only. Plastics provide the lustrous white or glowing red color, the translucency, and the everlasting high finish.

When you design or re-design your product, call on us at **MPC** for advice on the use of plastics. Draw upon our design and engineering experience . . . our production "know-how." We have the most advanced compression, injection and transfer molding equipment . . . supplemented by our own large tool room and extensive finishing facilities. Write to MOLDED PRODUCTS CORPORATION, 4535 W. Harrison St., Chicago 24, Illinois.

PLASTICS DIVISION

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If you are looking for a solution to some problem of high temperature processing, write for more detailed information to

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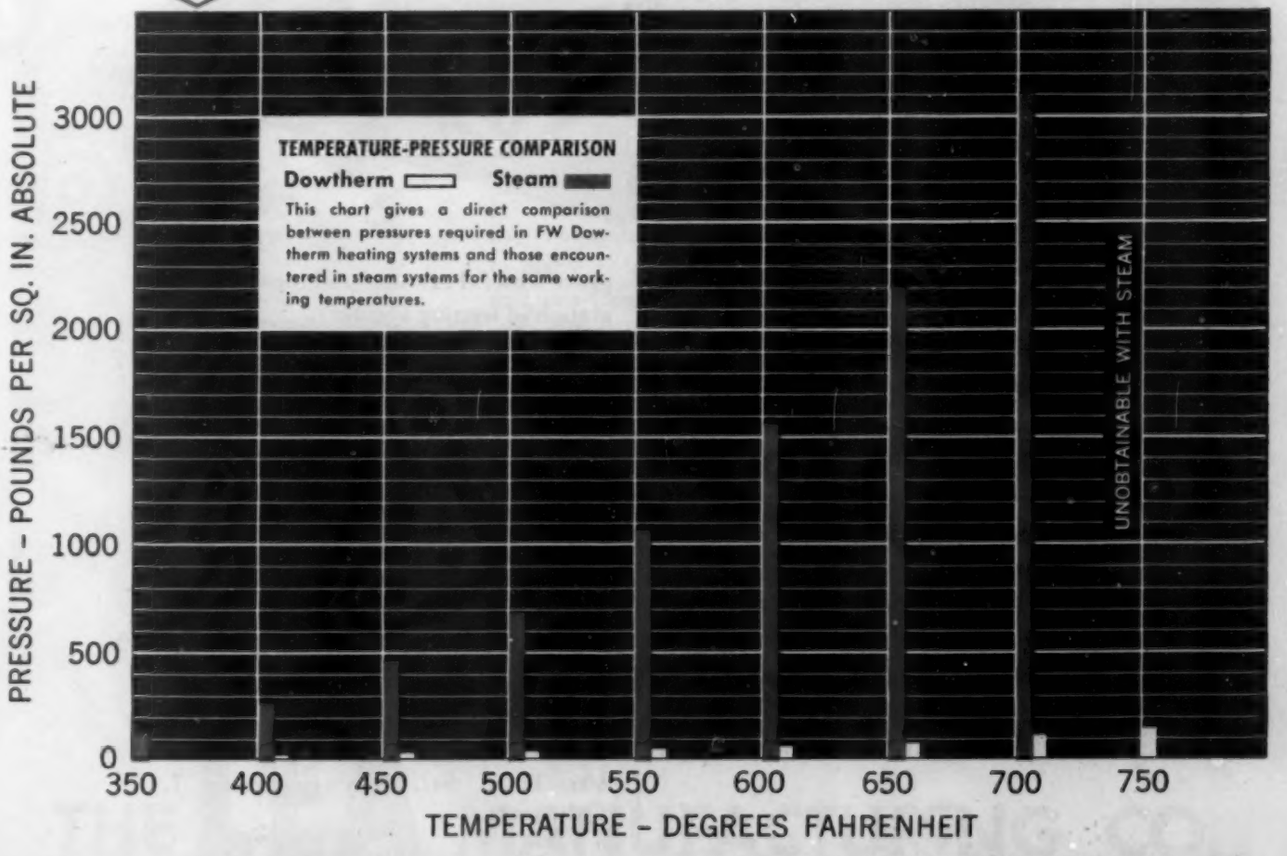

FOSTER WHEELER

ITACONIC ACID

Molecular Weight . . .	130.10
Appearance	White, crystalline, solid
Melting Point	167-168°C.
Solubility in Water . . .	At 20°C. a saturated solution contains 7.6 grams of Itaconic Acid per 100 grams of solution.

This unsaturated dibasic acid, now available in research quantities, offers many possibilities as a raw material in the field of chemical industry.

It can be used as a raw material in the preparation of resins of various types.

Its esters can be polymerized to yield colorless, transparent plastics of varying characteristics, depending on the alcohol with which the acid is combined. They can also be co-polymerized with other monomers, opening a wide range of possibilities.

Its structure indicates that it might prove a useful raw material for the preparation of wetting agents.

It can be converted to citraconic or mesaconic acid and forms an anhydride.

Reduction yields methyl succinic acid which, in turn offers other possibilities as a raw material.

Itaconic Acid is not yet being prepared in commercial quantities, but limited amounts are available for laboratory research.

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The adding machine case, illustrated here and manufactured by the Plastics Division of Continental Can Co. for Remington Rand, Inc., is typical of the quality plastic products in connection with which Lea Finishing Methods and Compositions play a vital production role.

If you are not completely satisfied with your present method of removing flash and other rough parts, or with the materials being used, why not consult LEA? Just send us the details of your problem and, if possible, samples for testing in our laboratory.

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BURRING, BUFFING AND POLISHING . . . MANUFACTURERS AND SPECIALISTS IN THE DEVELOPMENT OF PRODUCTION METHODS AND COMPOSITIONS

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Send your next inquiry to Grigoleit, the plastic molder with vision, who supplies plastics to many nationally-prominent manufacturers of styled products.

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The GRIGOLEIT COMPANY, Decatur 80, Illinois

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Give You More Assembly Advantages

Than Any Other Nuts, Regardless of Price

PREVENT VIBRATION LOOSENING

SPEED NUTS prevent vibration loosening because they provide a *double* spring-tension lock that *absorbs* vibration instead of merely *resisting* it. Insures a tight attachment for the life of the product.

SPRING TENSION RESILIENCY

In the assembly of porcelain enamel, plastic or glass parts, SPEED NUTS provide the tension necessary for a tight assembly, yet are sufficiently resilient to prevent damage due to expansion and contraction, vibration or shock.

APPLIED FASTER

SPEED NUTS put wings on your assembly lines because they start easier, pull down faster and no wrench is required to keep them from turning. Made also for use with coarse-thread sheet metal screws, requiring fewer turns to tighten, for still faster application.

ELIMINATE LOCK WASHERS

You can boot lock washers out the window, for SPEED NUTS are self-locking. They cut both material and handling costs. Because of their wide bearing surface, SPEED NUTS also can eliminate the use of spanner washers.

SELF-RETAINING

Many types of SPEED NUTS lock themselves in screw-receiving position for "blind" location assembly, eliminating expensive welding, riveting or clinching operations.

PERFORM MULTIPLE FUNCTIONS

Like a one man band, many special types of SPEED NUTS perform multiple functions, replacing two or more parts. SPEED NUT prongs can be incorporated in almost any shape or form to do the job easier and faster.

LOCK ON UNTHREADED STUDS

"Push-On" SPEED NUTS need only be pushed over rivets, nails, tubing, or unthreaded studs to lock parts so securely, you can't wrestle them off. Costly threaded inserts, drilling and tapping are eliminated—molding costs reduced—assembly speeded up.

WILL NOT CLOG

Having no threads, SPEED NUTS cannot clog with paint. No assembly delay for re-tapping threads. This is particularly important where SPEED NUTS are permanently attached to parts for blind assembly.

WILL NOT "FREEZE" TO THREADS

Having no threads, SPEED NUTS will not "freeze" to rusting bolts. They can be easily removed at any time for servicing or replacing. You'll save the repair men a lot of cussing.

WEIGH LESS

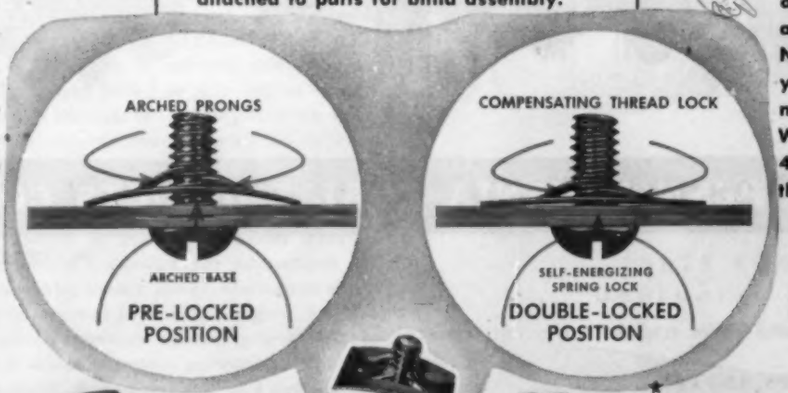
Because they are made of sheet metal instead of bar stock, SPEED NUTS are in the "featherweight" class compared with threaded nuts. By eliminating lock and spanner washers and other unnecessary parts, weight is reduced still further.

MINIMIZE SHIPPING DAMAGE

SPEED NUTS give you free insurance against shipping damage. They provide a resilient lock that defies loosening and prevents cracking of enamel and glass. With SPEED NUTS, your products will reach your customers in perfect condition.

SEND TODAY

We're not fooling about these advantages. They are very real and worth-while as any SPEED NUT user will tell you. Rush your assembly problems to us now, giving complete details. We'll show you which of the 4000 shapes and sizes will do the trick for you.



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HY-MAC

PLASTIC INJECTION MOLDING MACHINE

MODEL IM-2

a Warren Broad design

Following are the outstanding features of the new Hy-Mac Model IM-2 Plastic Injection Molding Machine:

Two electronic **TEMPERATURE CONTROLS** regulate heat in chamber and nozzle with guaranteed accuracy of plus or minus two degrees. **MOLD CLAMPING** is achieved by toggle action which insures perfect alignment in closed position. **PLATENS** are of semi-cast iron; designed for maximum strength with minimum weight. **CLEARANCE** of 12½ inches is provided between strain bars both in top and sides. Platens are adjustable to hold **DIE** of 5½ inches (min.) to 9½ inches (max.). Maximum **PRESSURE** of the injection plunger is 28,400 psi when operating at 1,000 psi line pressure. Pressures may be reduced to zero. The **INJECTION STROKE** has a 3-second cycle for full 8 inches, traveling at 100 feet per minute. **METERING DEVICE** accurately controls amount of material entering injection cylinder. Easily adjustable for different types of molds. Two **TIMERS** installed in the panel control injection piston and mold clamping time. Easily accessible for adjustment. All **CONTROLLERS**, including switch relays, timers, temperature controllers, and motor starter, are electric and located in a single panel. **SAFETY DEVICES** include safety gage, which prevents operating while either gate is open; and a safety switch which prevents operation if for any reason toggle fails to clamp the mold. Although rated at 2 ounces, the machine has a 50% overload capacity.

Write, wire, or phone for complete technical description.

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"Standard procedure" is not good enough. We have learned many things that are not in the books on how to inject *added* value to the orphan pounds of plastics that never go to market.

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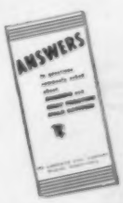
"Masters of Magic in Thermoplastic conversion"

General Electric Co. used Carpenter *No. 158* Mold Steel to make this radio cabinet mold cavity.

Today one sure way to cut your molding costs is to protect every single hour and dollar you invest in making a mold. For example, here's a radio cabinet mold cavity that required many weeks to make. And once on the press, uniform hardness, and high core strength with freedom from sinking were vital. Because the mold maker needed a steel that would meet these "specs", Carpenter *No. 158* Mold Steel was selected. The results were long, trouble-free runs with smooth, high-lustre finishes.

You can now protect the time and money spent on each and every mold you turn out. Use clean, acid-inspected Carpenter Mold Steels. And for personal help that can cut your mold making costs and improve mold performance, contact your nearby Carpenter representative today.



If you haven't already sent for your free copy of "Answers To Questions Commonly Asked About Hobbing And Heat Treating Mold Cavities", drop us a line. A note on your company letterhead, indicating your title, starts this useful Carpenter leaflet on its way.

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Thru research, important information and facts are obtainable which guide product development.

PMI is prepared to do both the Research and Development to help solve your problem of design or performance, and to produce the molded plastic that serves your product needs most efficiently and dependably.

Thru sound plastics engineering, and by working closely with manufacturers' and their engineers, we have developed designs to meet difficult performance requirements. Frequently we are able to solve product problems by the use of original techniques in plastic molding. This too is a part of PMI Research and Development.

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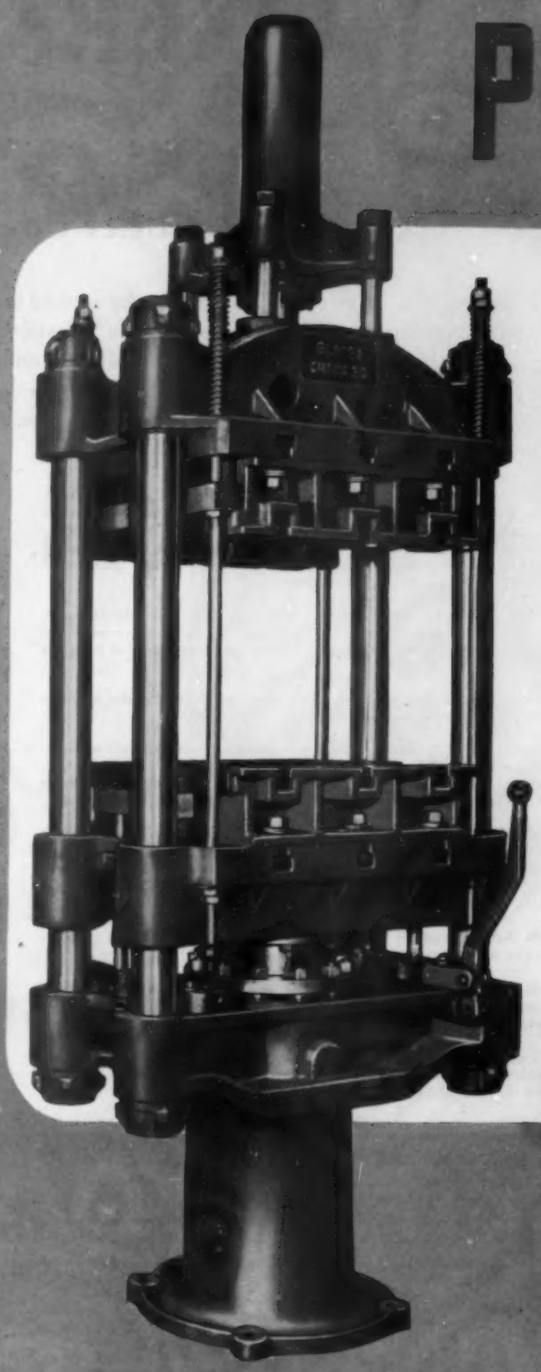

Whatever your transfer molding needs, you'll find that Elmes builds *exactly* the press for you. Intimate knowledge of molding problems is combined with long-time experience in molding equipment to give you the kind of performance you want.

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Elmes transfer molding presses may be complete and self-contained, or without the motor and the cooled and filtered pumping unit when intended for accumulator operation. Manual or time-cycle push-button control is optional. Independent control of transfer ram, with or without time cycle, is available when desired. All have interchangeable transfer ram heads, and top and bottom bolsters.

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Emery makes three types of "Plastolein" products to be applied in a broad sense to the industries manufacturing "flexible" plastics. Specific uses include those for synthetic rubber, solution and dispersion coatings (for metals and cloth and paper, etc.), as well as for baking and air-drying alkyd enamels. The properties of each class are outlined by the typical examples below:

"PLASTOLEIN" X-55—Diethylene glycol dipelargonate or "Plastolein" X-55 has an average boiling point of 232°C at 5mm pressure. It is soluble in most common solvents and compatible with most of the vinyls, nitrocellulose, ethyl cellulose, cellulose acetate-butyrate, methyl methacrylate, etc. Suggested for elastomeric extrusions, surface coatings, coated fabrics and plasticized films. Excellent low-temperature performance.

X-58 DIOCTYL AZELATE—"Plastolein" X-58 is a very light-colored ester, boiling point 255-258°C at 7mm, low volatility—excellent elasticity—superior plasticity at low temperatures, economical—less plasticizer needed per unit of plastic.

X-66—Triethylene Glycol Dipelargonate—properties generally the same as "Plastolein" X-55, slightly less volatile.

X-282—A mixed-ester plasticizer—a low-cost primary plasticizer for nitrocellulose, a good secondary plasticizer for the vinyls. Good color stability, excellent adhesive characteristics. Plastolein X-282 — is recommended for Pyroxylin cloth coatings and air-drying metal finishes.

"PLASTOLEIN" X-548—A low-cost, ester-type plasticizer developed especially for Buna N mixes is also compatible with nitrocellulose, ethyl cellulose, and with some of the vinyls like the butyral. With others like the chloride, "Plastolein" X-548 is recommended as a secondary plasticizer, X-548 imparts exceptional ultra violet stability to compounds.

PLASTOLEIN AA—A special fatty acid, maximum titre 5°C, iodine value 135-140, for the manufacture of baking and air-drying, alkyd enamels.

L-110—Azelaic Acid, a dibasic acid, $C_7H_{14}(COOH)_2$, for the manufacture of soft alkyds and resinous-type plasticizers. Insoluble in cold water, infinitely soluble in hot water. Soluble in alcohol and other polar solvents.

L-114—Low molecular weight, mono-basic fatty acids containing a high percentage of pelargonic acid, $C_8H_{17}COOH$. Recommended for oil modification of alkyds and the manufacture of perfumes, and plasticizers.

STEARIC ACID ($C_{17}H_{35}COOH$)
An excellent lubricant to facilitate molding and extruding operations. Can be incorporated in resin mix or dusted on mold.

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For alkyds, as a plasticizer for synthetic rubber mixes, and an all-purpose emulsifying agent when properly compounded.

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MODERN PLASTICS

VOLUME 24 DECEMBER 1946 NUMBER 4

KODACHROME, COURTESY SYLVANIA ELECTRIC PRODUCTS, INC.

Xmas and plastics work hand in hand

THE safety and beauty that plastics bring to our way of living are typified in the uses that are made of these materials at Christmas time.

In the Christmas tree, our symbol of this season of the year, plastics are playing an ever bigger role—in the lighting equipment as lamp bases, wire insulation and decorative light covers and shields, and in the trimmings as blown balls and all types of molded and fabricated ornaments. A comparatively new mass market for plastics, this use of the materials is covered in the article that follows on the next page.

As for the things under the tree, they are the essence of the huge gift market where plastics are well established both in luxury goods and in the stocking fillers and novelty items that fill the stores the year round. Here plastics' color again comes into play backed by variety of forms and textures, formability, resistance to so many chemicals and ease of cleaning.

On pages 94 through 101 we have picked three broad groupings from the gift field to show just how all these qualities are brought into play to improve the value and saleability of the products. While we have limited ourselves to reuse packages, this type of box does not by any means exhaust the uses of plastics in packages, especially in the cosmetics fields, where eye appeal is a compelling factor. Nor does plastics in packages exhaust the applications of these materials to the beauty field where they appear as containers for various items.

Merry Xmas with plastics

Plastics' formability, its color and the fact that it is less fragile than glass point to its increased use in decorations

by F. A. ABBIATI*

"Merry Christmas with plastics" has a double significance here. Not only does it suggest the increasing role that plastics are playing in the Christmas decoration market but it shows just what plastics can do in this field, for the "Merry Christmas" is an actual window greeting fabricated by Vio-Glo Plastics Corp. of New York City from fluorescent cellulose acetate and activated by a black-light unit in the back.

Surprisingly, the use of plastics Christmas decorations is comparatively new. It was during the Christmas season of 1940 that thousands thronged the mall at Rockefeller Center to see in all its glory the huge tree emblazoned with the first plastic ornaments. This year, for the first time, counterparts of these plastic decorations will be available for tree decorations in the home.

When the first huge tree was decided upon at Rockefeller Center, it was soon discovered that conventional decorations were too small and were lost in the towering heights of the 75 ft. tree. To design new decorations necessitated the choice of lightweight material not easily damaged by exposure to the elements. Plastics led the materials field and drawn acetate balls were decided upon. The electric light sources were placed within the globes to provide the visible color. Conceived and designed by Robert Carson, architect and designer for Rockefeller Center, the decorations were fabricated by Design Center, Inc., of Long Island City, N. Y.

Last year was born the idea of using molded fluorescent styrene globes excited by black-light (near ultraviolet light) for the 75 ft. tree. Design Center again entered the picture and more than one thousand 10 in. diameter globes were prepared, injection molded in two pieces and bolted together. This year the light source is being increased to offset the visible normal illumination found in the area.

Following the successful experiments with the Rockefeller Center tree, skilled artisans of the plastics industry have contrived beautiful decorations for this year's home Christmas trees. These new decorations will more than make up for the scarcity of finely blown glass decorations from Czechoslovakia upon which we formerly depended for color in our Christmas trees.

* General Manager of Sales, Monsanto Chemical Company's Plastics Division, Springfield, Mass.

Christmas lighting

Last year saw the introduction by Sylvania Electric Products, Inc., New York City, of round fluorescent Christmas tree bulbs held by molded phenolic bases. These are the lights used on the tree picture in four colors on page 89 of this issue. This year the Noma Electric Company of Holyoke, Mass., is marketing an electric bulb, called Bubble-Lites, which, basically, is a candle-shaped glass tube, filled with a colored, low-boiling point liquid, mounted directly on top of a small 15 volt bulb. The bulb is set inside a translucent colored cellulose acetate or styrene globe from the top of which projects the glass tube and from the bottom of which extends the threaded metal end of the light bulb which, in turn, screws into a compression-molded phenolic socket. The assembly is completed with colored vinyl-covered electric leads.

The novelty of the product is that the small heat generated by the bulb is sufficient to bring the liquid in the glass tube to the boil so that, very shortly after the lights are turned on, an unending stream of bubbles chase each other up through the colored liquid.

The fluted globe containing the lamp bulb is injection molded in two halves which are subsequently cemented together. Two molding companies—the Gemloid Corp. of Elmhurst, N. Y., and Bridgeport Moulded Products, Inc., of Bridgeport, Conn.—turn out these plastic parts to supplement the production in the Noma Company's own plant. The rest of the parts of the light are so assembled that only the bottom end of the glass tube comes in direct contact with the lighted bulb.

From the West Coast comes another unusual string of electric lights. Consisting of 25 light sockets, it is designed to take the shape of the tree itself. The main branch of the string is constructed so as to fasten to

the trunk of the tree with a socket at each of four levels and one at the tree top. From each of the four central sockets three additional lines branch out—branches for the bottom sockets being longer than those further up. The top two strands have one additional light socket per branch while the three other levels are provided with two sockets per branch. Using this set, it is a simple matter to evenly distribute and balance the lights on a tree. The husks and terminal boxes for this set are compression molded of green phenolic by Roger Manufacturing Co. of Oakland, Calif.; the sets are assembled and sold by the Eddy Manufacturing Co. of Hayward, Calif.

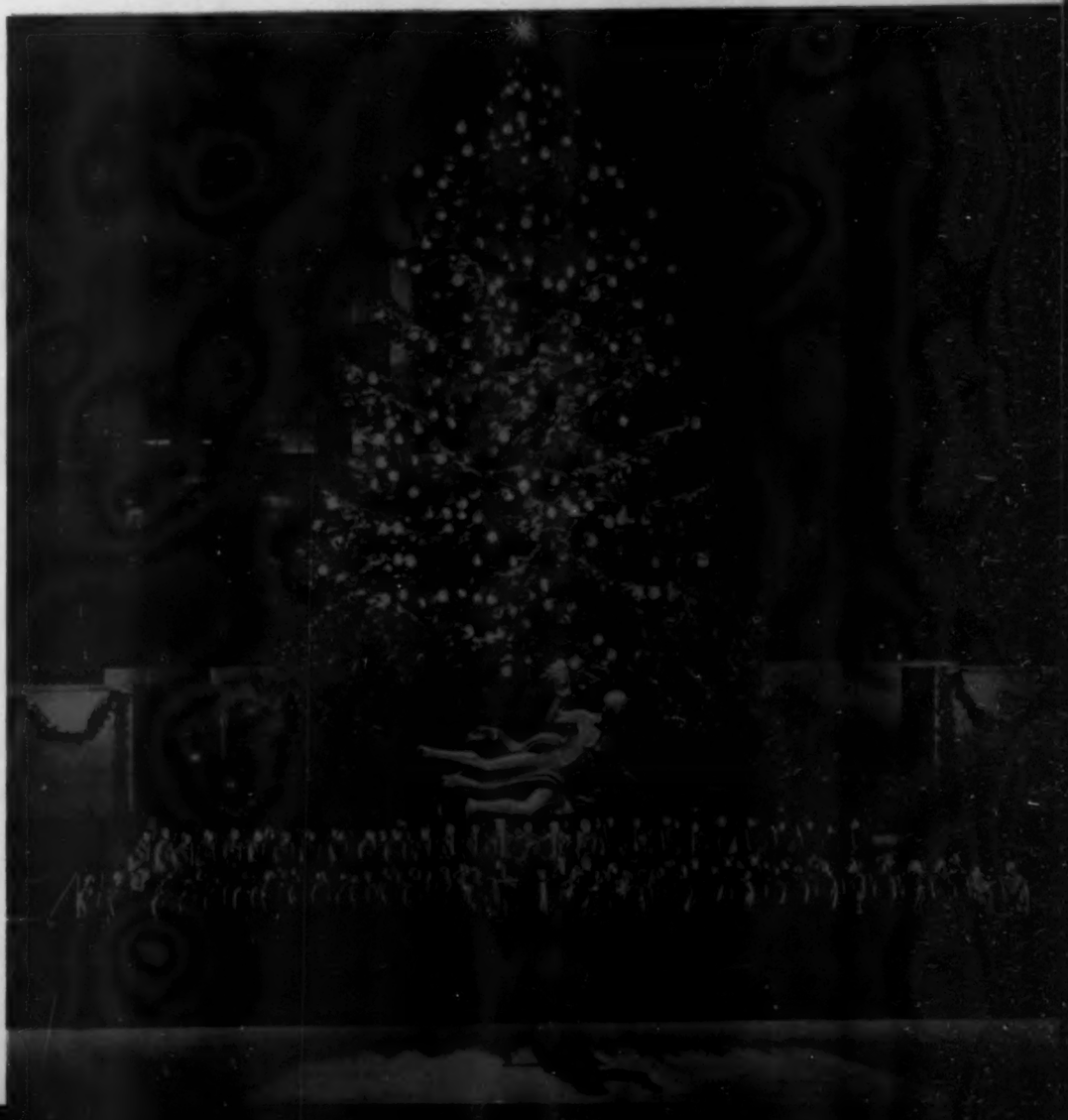
Plastic ornaments

One of the most intricate and beautiful Christmas tree items is the fluorescent snowflake (page 92) being injection molded of styrene by Design Center, Inc. These thin flat snowflakes reproduce in every fine detail all the minute crystallizations of real flakes. Available in a broad range of colors they are beautiful by daylight—but under the excitation of black-light the fluorescent pigments give off a gleam, sparkle and fire that is breath-taking.

The Noma Electric Co. is also making decorations, injection molding halos of clear styrene, for example, which fit around electric bulbs on the tree and provide excellent edge-lighting as well as a halo effect. Another innovation of theirs is an angel designed to fit the top of the tree. The halo behind the angle's head is also molded from styrene. A tree-top star whose five points are styrene is an good example of edge-lighting (page 93).

Blown acetate Christmas tree balls, ranging in color from whites and pastels to the deep reds and greens traditional to Christmas tree decorations, are being produced by the Plax Corporation of Hartford, Conn. The brilliant colors and the seemingly high polished surface of these ornaments provides all the sparkle and glimmer usually available from glass fixtures, yet the plastic decorations are safer with children in the family and are nowhere near as breakable as the glass ornaments which in the past have been so common.

Also prominent among the decorations now available are the formed fluorescent acetate pieces manufactured by the Vio-Glo Plastics Corporation. Formed bells of various sizes, artificial candles, balls covered with chips of fluorescent materials, and feathered strips to replace the tinsel for "black-light" decoration are some of the items being manufactured. (Page 93.) This firm markets a household "black-light" unit for exciting the fluorescent pigments in these articles. The Vio-Ray light source is a standard size fluorescent lamp to which



The 1940 Christmas tree for Rockefeller Center, New York, started plastics in the Yuletide decoration field. Last year there were over one thousand specially designed styrene globes made to enhance the Center's tree

Delicate snowflakes for adding sparkle to Christmas are injection molded of fluorescent styrene. They illustrate the intricate designs that can be faithfully reproduced

Stars, crescents, bells and balls made of styrene foam are light and shatterproof which makes them ideal for decorating small trees as well as counter displays

These ornaments, because of their non-flammable, unbreakable qualities, are specially suited to trees decorated for children. They are molded of polystyrene in 4 colors

is processed a plastic filter. While permitting the passage of near ultraviolet light, the filter absorbs unwanted visible light. Thus, a blacklight unit is available at comparatively low cost to the normal household.

The Union Novelty Co. of New York City is also marketing fluorescent ornaments fabricated from acetate. These ornaments are sold in kits which include a tree top star, bells, feathered ribbons, balls, candles, small double stars, icicles, snowflakes, pine sprays and "snow powder," or chips of fluorescent acetate. The use of black-light and fluorescent plastic decorations is opening a completely new era in the decorating of Christmas trees at home and elsewhere.

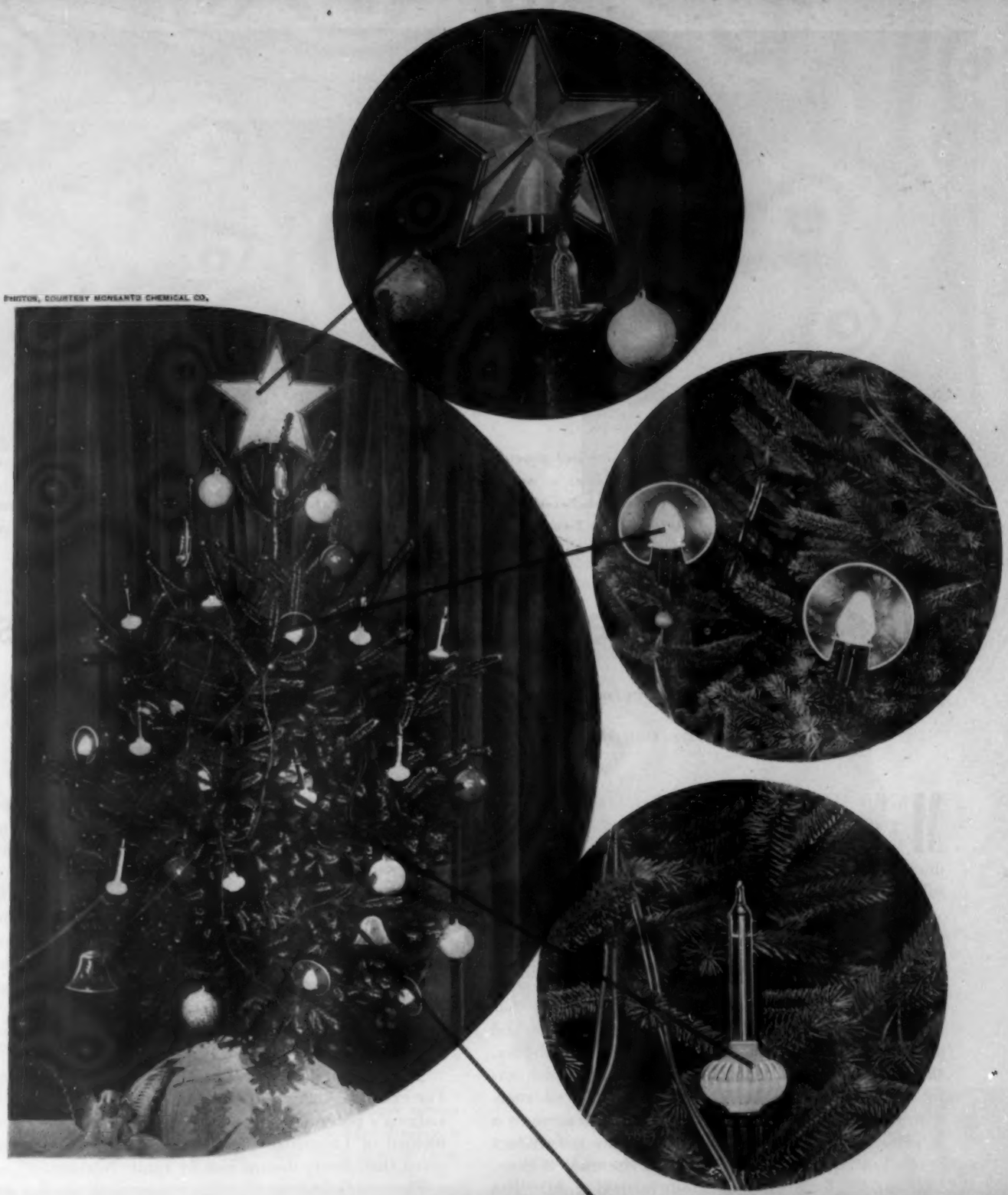
An injection-molded tree-top star with an interior light source has this year been added to the line of Christmas tree decorations being manufactured and sold by the Raylite Electric Corporation of Long Island City, New York. The star is molded in two pieces of white translucent styrene and the two halves are held together with spring clips, making replacement of the light bulb an easy matter.

The Bo-Jo Molded Products Co. of Hollywood, Calif., has also brought out a Christmas line consisting of bells and stars injection molded of styrene in red, blue, green and amber. Southern California Plastics Co. of Glendale, Artcraft Plastics Corp. of Culver City, Aljac Plastic Co. of Inglewood and Plastic Die and Tool Corp. of Los Angeles do the molding of these stars and bells for the Bo-Jo Company.

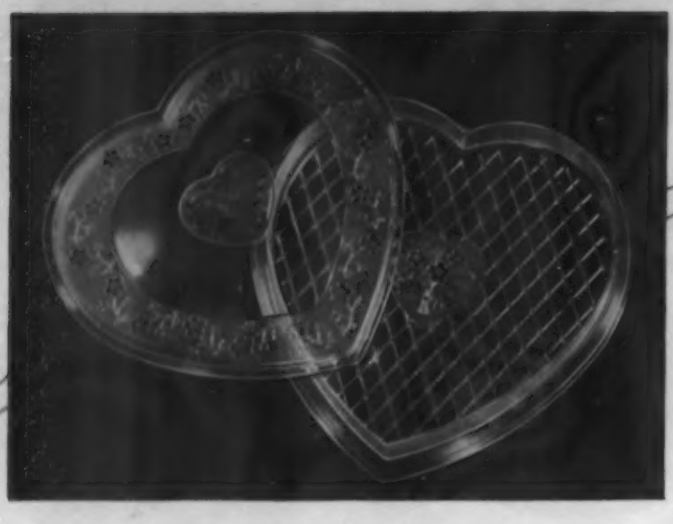
Entirely different are the snow-like stars, crescents and bells produced from styrene foam by Maharam Fabric Corp. of New York City. They have the advantage of being extremely light in weight and may be had in gold and silver as well as in white to enhance the beauty of the trees.

The infinite detail that can be obtained in molding plastics, together with the broad range of colors available and the fact that plastics are far less fragile than thin glass ornaments, points to an increasingly larger demand for plastic for Christmas tree decorations in the year to come. This year really marks the entry of plastics into this field on any large-scale basis. Next year, when materials are more available, the use of plastics in this decorating field will, beyond a doubt, be at least quadrupled.

PHOTOS, COURTESY MONSANTO CHEMICAL CO.



Every decoration on this tree is made possible by the use of plastics. Close-ups of three of the decorations (circular pictures, top to bottom) show effective styrene applications—the white translucent molded tree-top star; crystal clear halos with excellent light piping properties; and the candle having a bulb in the base which causes the liquid in the upper section to bubble. Right—This assortment of drawn and fabricated acetate Christmas decorations are designed for activation under ultraviolet rays



1—*In order to attract the customer's eye—and provide him with a decorative, light, reusable box, a candy manufacturer has recently marketed this heart-shaped candy box which is molded of styrene in a 2-cavity die*

PHOTOS 2 AND 5, COURTESY MONSANTO CHEMICAL CO.

2—*Cellulose acetate makes these miniature hat boxes and the large box which can be used for display or storage*

Plastics make good reuse packages

Plastics' special advantage for this type of use is its strength, coupled with formability and color range

MANUFACTURERS of so-called luxury goods are always seeking new ways of attracting customers, new ways of inducing customers to buy their products. One sales approach that has been adopted by various manufacturers of jewelry, cosmetics, candy, perfume and style accessories involves a reuse package. This means that in addition to the usual packaging material requirements of good looks, color and formability the manufacturer has added a specification reading "long-time sturdiness and good finish" or, if the package is to double as a display, the qualification of transparency. All of which explains the increased use of plastics for this type package.

A good example of a package designed to serve as a display as well as a permanent container for the product is the Lustron case molded by G. Felsenthal & Sons, Chicago, Ill., for the Stahly Stroke razor (Fig. 5). The transparency of the top half of the case, a must for good display, makes the razor easier to locate on crowded bathroom shelves. And the cover can't topple off, for it is permanently attached to the black and red styrene base on one side and hinged to the base on the other.

Slightly different, but meeting much the same conditions of use, is the fabricated acrylic display for Magic Hour perfume which is a clear invitation to purchase and cherish the product (Fig. 4).

Cellulose acetate is being used in both fabricated and molded form for reuse packages. Perhaps its most novel application this Christmas is in the Vuepak hat boxes which are fabricated by Plastic Artisans of White Plains, N. Y., for Frank H. Lee Co., manufacturer of men's hats (Fig. 2). The miniature hat in the miniature box is sold with gift certificates, which are considered a necessity in merchandising hats as gift items because of the "try-ons" required. The miniatures meet the universal desire to present something concrete as a gift, and at the same time lend themselves to later use as a trinket box.

There are endless variations on this gift package idea. For example, there is the line of containers for Lucien LeLong's perfumes and cosmetics (Fig. 6). Injection molded of Lumarith, the tops of these packages are given their frosty decorations by Emile Norman.

The candy industry is also represented among the industries interested in reuse packages. One example of what can be done with plastics in this field is the heart-shaped candy box in Fig. 1. Lightweight container is molded of Styron and Lustron in a 2-cavity die by Amos Molded Plastics of Edinburg, Ind., for Alden Plastics Corp.

The jewelry industry has been one of the slowest in the luxury class to adopt modern packaging. In fact, until the first World War, boxes were not used at all. But once this tradition was broken by Bulova it was not

PHOTO, COURTESY DOROTHY GRAY, LTD.

3—(Above) Styrene is used in these molded jewelry boxes—the larger one for pearls, the smaller for children's jewelry. 4—(Right) Acrylic box protects, displays perfume

long before jewelry firms of all types were experimenting with various packaging materials

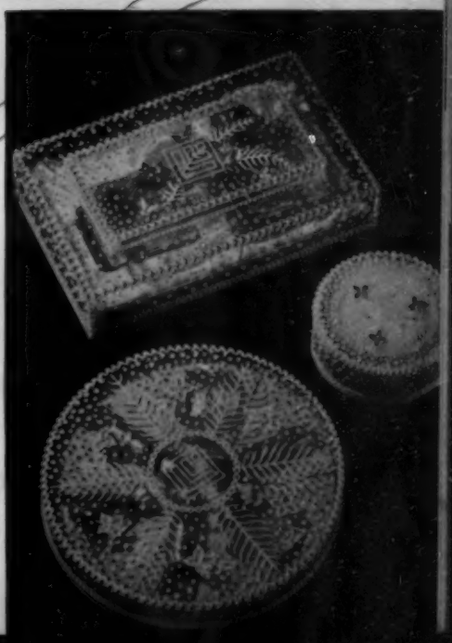
Typical of the present use of plastics by jewelers are the boxes in Fig. 3, which were designed by Braun-Crystal Mfg. Co. of Middle Village, N. Y. The two-piece ivory box for the Speidel Corporation's line of children's jewelry is molded of Loalin in a 6-cavity combination die and finished with a velvet pad and satin lining. In developing this box the requirements for both display and reuse were kept in mind—the hinge being designed so the lid would snap back to give a full view of the contents and the legs being reinforced to insure long wear. The pearl box for L. Heller & Son, Inc. (top, Fig. 3) is also molded of styrene and finished with a velvet top, the lid being designed with cross pieces to permit easy insertion. In both boxes, liner can be removed, turning cases into jewelry boxes.

Braun-Crystal also designed the container in Fig. 7 for Crawford Watch Corp., the modern lines being a departure from the soft plastic and velvet of the boxes just described. Both the top and bottom are of Loalin—the top being red, the bottom black. It is only necessary to remove the inner pad to have a perfect cigarette box.

5—(Above) A molded styrene razor container with clear top and black and red base can be reused as a permanent and convenient holder

7—Cut-out front of this styrene watch container makes reaching for a cigarette easier. When used for display, a molded-in price tag slot inside box helps sale of item

6—(Right) Frosty decorations enhance the cellulose acetate cosmetic containers and insure success for reuse purposes in home



Plastics sell as well as hold cosmetics

Attention value and good strength characteristics are the basic elements in good container design. That is why plastics are playing a bigger role in this market

PHOTO, COURTESY CELANESE PLASTICS CORP.

1—*Cellulose acetate shaving bowls are light and durable*

2—*(Above) To insure the molded urea cap fitting squarely, bottle is fashioned with a pyramided shoulder which matches pyramided inner edge of closure. Molded-in rod fits into cork in neck of bottle*

SOMETHING new, something different—that's the cosmetic field. You see it in the products and you see it in the containers. But, just as the basic ingredients of the cosmetics remain the same, worked into different forms and different combinations, so the manufacturers of these products have found that they can settle on plastics for their containers and, by varying the type and handling of these materials, come up with entirely new packages.

The newest development in the cosmetic field—styled toiletry for men—bears testimony to the adaptability of plastics to the particular needs of a field. In this application, good wear and strength characteristics are essential, for man will not be bothered with products that need careful handling. At the same time the containers must be restrained and tailored in appearance so their owner will feel no diffidence in using them in the club house and on the train as well as at home. But they must still be able to catch the eye, for women are big buyers of this type of toiletry.

Courtley Ltd. has done well on all three of these points of sale—wearability, restraint and eye appeal—by adopting injection molded Lumarith containers for their shaving bowls (Fig. 1). Available in dubonnet, white, black, moss green and saddle tan, the containers are easy to handle because of the light weight of the cellulose acetate and they keep their good appearance since the color goes all the way through. Ma-Mac Products Corp. of Los Angeles does the molding.

Mark Cross is doing much the same type of work on its men's Cross Country line (Fig. 3) except that this

3—*Phenolic was found to give style to these jars and caps*

PHOTO, COURTESY NORTHAM WARREN

4—Lightness, style are the virtues of this phenolic case

PHOTO, COURTESY MARY CHESS, INC.

5—Silver coated urea stoppers add dash to these bottles

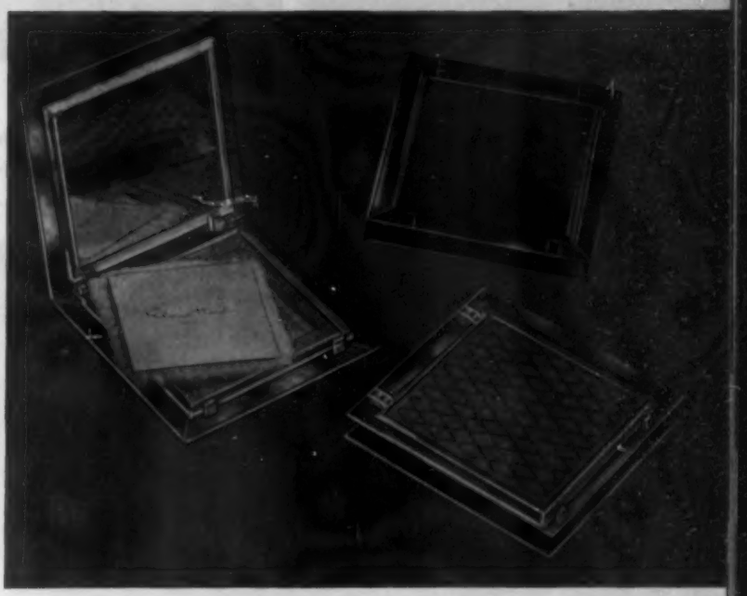
company has gone further with its use of plastics and has found Durez material to best fill its needs. Caps for all the bottles in this line and four black plastic containers—for talcum, after-shave powder, shaving stick and shaving bowl—are injection molded by Norton Laboratories, Inc., Lockport, N. Y. The rich brilliant black surfaces are livened by the Mark Cross crest rubbed in on the tops in gold and by the Cross Country name and scroll in gold on the sides of the tall containers. The same chunky type cap used on the bottles is adapted for the closure of the after-shave powder and shaving stick containers. The powder box and bowl have lids designed with a raised disk portion to simplify handling when opening. The lid of the powder box is threaded as well as a protection against spillage.

A new type of bottle cap

An innovation in closures that has significance both for manufacturers of women's and men's toiletries is the square bottle cap developed by Alfred D. McKelvy. Introduced with Vice-Versa and Et Cetera perfumes, these caps are now appearing on bottles of Cargo shave lotion, talcum and cologne, specially prepared for men by Duncan Storm, Ltd. (Fig. 2).

Originally the square closure was produced on the screw-cap principle. This worked well for the first few times but after threads start to wear there is no way of making the four corners of the square cap fit exactly with the shoulders of the bottle. To overcome this problem the designer created a special bottle with pyramided shoulder. He then designed his square cap so the lower rim had concave pyramided sides matching those of the bottle. With this construction the square cap can rest securely on the bottle in only one position—and that is with its sides flush with the square sides of the bottle. For greater firmness and as insurance against leakage, the necks of these bottles are fitted with a cork and the caps designed with a rod that extends downward from the center and is held by friction within a hole in the bottle cork.

While this ingenious cap might, without its center rod, have been produced economically



6—There is no bulkiness in molded acrylic compacts

of a material other than plastics, with the rod, plastic was the logical answer—urea to be specific—since it permitted the cap and rod to be made in one piece. As an extra eye catcher this firm is marketing a Cargo travel kit, three bottles being packaged in a 2-piece molded phenolic box. The spirit of the name Cargo is carried out in the design on the case lid.

Women like change

Powder, manicure accessories, perfume, lotion, lipstick—they are all to be found packaged in plastics, and in almost every type of plastic. There is the Cutex set in Fig. 4 which is molded by Northam Warren of Stamford, Conn., of Durez, Bakelite and Resinox. The cover and base are each produced in 4-cavity dies while the cotton boxes are turned out in a 16-cavity mold (8 boxes for the right side and 8 for the left). One of the first all-plastic postwar manicure sets to appear on the market it has the advan-

PHOTO, COURTESY DELAWARE PLASTICS CORP. 7

PHOTO, COURTESY YARDLEY OF LONDON, INC. 8

PHOTO, COURTESY JACQUELINE COCHRAN 9

7—The use of cellulose acetate made possible the approximation of jade in this lipstick cover. 8—Urea forms the cap of this jar. 9—Five tiny molded jars are threaded so they screw together to form this stick

PHOTO, COURTESY ELIZABETH ARDEN SALES CORP.

10—*Acrylics are ever popular for style and lightness*

tage of compactness, a streamlined form and a sanitary appearance as well.

In a different way Mavco in New York City has also used plastics to achieve a streamlining and reduction of bulk in its new Eleanor Hamlin square cut compacts (Fig. 6). The outstanding impression of these compacts is their thinness and lightness of weight. But they also have a styling that blends with fashion by day and by night. Truly plastic, even to the hinge, the compacts are molded of Plexiglas in 4-cavity molds. The three patterns for the top, which comprise either a series of dots, criss-cross lines or lines forming a diamond-shaped design, are molded-in and subsequently sprayed with color before the mirror is inserted into the lid.

Perfume may not be bottled in plastic but it derives much of its sales appeal from plastic caps like the one used by Mary Chess (Fig. 5). Like the shaving stick for men put out by the same company the bottle tops are of Beetle, molded by A. J. & K. Co. of Colchester, Conn. The gilding and silvering are the work of Electro Plastic Processes of Chicago.

A cap of another kind is the cover for the new jade Chen Yu lipstick (Fig. 7). This cover is a fine example of three of plastics' outstanding characteristics—the ease with which it can combine with non-plastic materials, the way in which it can be formulated to meet certain conditions of use and its color potentialities. A special Lumarith formula was selected for this application because it was essential that the material retain its form and possess minimum chemical reaction. And, to meet the cosmetic companies' sales ideas the color had to be that of jade. These cellulose acetate cases are molded by Superior Plastics of Chicago, Ill., for Associated Distributors.

Almost like giant lipsticks, thin tubular multipart make-up kits are beginning to appear on the market. There is, for example, the Perk-up set of Jacqueline Cochran in Fig. 9 which is produced by the Plastic Div. of Colt's Patent Fire Arms Mfg. Co. of Hartford, Conn. One inch in diameter by 3 in. in length, the case is really five tiny jars that screw together to form one tube.

A variation of the familiar plastic closure is the Plaskon cap on Yardley's sachet pouch bottles (Fig. 8) another example of the work of the Colt's Patent Fire Arms Mfg. Co. In fact, variation, as stated previously, is one of the special advantages of plastics in the cosmetic field. Elizabeth Arden's Lucite Powder box in Fig. 10 is a luxurious starting piece with an attractive design that can be modified or elaborated for all types of markets.

Adult games make a 3-way use of plastics

The color, wearing qualities and the formability of plastics lend variety and serviceability to a field in which the end product is somewhat standardized

THE game industry is, for the most part, a gift field. That is shown by the fact that approximately 50 percent of the normal year's sales are made in the month of December. Being a gift field the games must make a good appearance, be colorful, have an appearance of quality. And, so far as adult games are concerned, they are expected to last.

Little wonder then that plastics have carved for themselves so firm a niche in this field, for they have the surface finish, integrated color, light weight, formability and ruggedness that the customer wants in the adult games he buys. And they can be made up in a range of prices to meet every purse. In them are to be found (as shown in the illustrations accompanying this article) cast phenolics, molded phenolics, urea, cellulose acetate and polystyrene.

Study of the various U. S. Government statistics shows that the trend of consumer demand for adult games—for all toys and games, in fact—is closely related to the trend of the gross national product, the consumers' disposable income and population. Thus the low mark for games was reached in 1932 with a drop of approximately 33 percent from 1929. While the slump of 1937 interfered with the rise to 1942, in that year the gain over 1932 amounted to 92 percent. And since that time the rate of annual growth has amounted to 6.73 percent. What this means for the future may be estimated, assuming conditions do not change m

terially, from the $1,455,127 figure set down by the Census of Manufacturers as the manufactured value of dominoes, checkers, chessmen, dice, poker chips, etc., for 1939.

For the most part the games that are now on the market are but slightly different from those that were manufactured before the war; in fact, many firms have made no change in their line. Poker sets and accessory equipment are perhaps the exception. Quite new is portable unit in Fig. 2 and the three in Figs. 3, 4 and 5.

Cast and molded phenolic poker sets

With enough tricks to attract any eye is the poker set molded by Industrial Molded Products Co. of Chicago, Ill., for Count-Rite Industries, Inc. (Fig. 2). It is compact, easy to assemble, light in weight and

1—Hand-carved cast phenolic chess add color to board

2—This poker set uses molded phenolic for cover, the revolving rack, the handle and the knob. The chips, however, are of urea, made up with a special tapered design

PHOTO, COURTESY SELMAN MFG. CO.

3—Luxury appearance and a soft pleasant texture are the important qualities imparted by cast phenolic to this unit

PHOTOS 4 AND 5, COURTESY E. S. LOWE CO., INC.

4—The yellow rack for these poker chips is fabricated of cast phenolic. The bright colorful chips are molded of urea

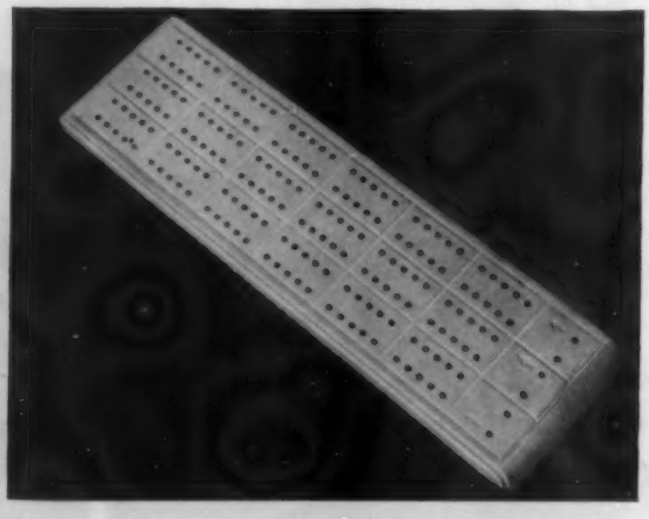
5—Molded phenolic is to be found in the case, cover, ash trays and coasters of this set. Styrene is used for the chips

PHOTO, COURTESY ARTHUR POPPER

6—Almost all the items in this set are of cast phenolic. The money pieces, however, are molded of urea material

PHOTOS 7 AND 8, COURTESY METRO MFG. CO.

7—It would seem that every type and size of domino were present in this array of easy-to-clean cast phenolic pieces



8—This ivory urea cribbage board is designed with a slot on underside large enough to hold the pegs of three players

with several easy-to-operate features that offer something new in the way of gifts. The outer housing, the revolving rack, the handle (which is molded separately from the cover) and the knob which screws the cover in place are all molded of black general-purpose phenolic material. Tapered chips are of Plaskon and Beetle.

The cover presents no special molding problem since the handle is molded separately and held by screws. But it is a different matter with the revolving chip holder where differences in wall thickness and the depth of draw present difficulties and necessitate a cure of 7 minutes. The single cavity mold for this piece contains 8 cores for the stacks of chips and the two slots for cards—the latter being finger grooved at the side.

An octagonal molded piece, not visible in the photograph, goes on the bottom of the revolving rack where it is fastened by screws. This piece engages a flat steel spring as the rack is rotated, properly indexing the columns of chips so mechanism can engage them.

The game set (Fig. 5) is being produced by the Warehouse Point Company is also of phenolic, except for the polystyrene poker chips. Beside the rack itself there are 6 plastic ash trays and 6 coasters held in specially designed circular fixtures at either end of the case. End containers also serve as cribbage markers.

Northwest Plastics, Inc., of St. Paul, Minn., mold all the components of this Hospitality game set. The poker chips are turned out in an 18-cavity injection mold while the case is compression molded in a single-cavity die, the cover in a 4-cavity mold and the coasters and ash trays in 6-cavity molds. Besides the advantages of plastics mentioned above, the manufacturer found the unit could be produced cheaper from phenolic.

The old favorite of many game manufacturers, Catalin, is the material employed in the fabrication of the units in Figs. 3 and 4. Selwin Mfg. Co., East Orange, N. J., in its set that combines ash trays and chip holders, does all the assembly itself from rough castings supplied by another company. Much the same is true of E. S. Lowe Co. of New York City and its yellow cast phenolic rack with Plaskon chips in various colors.

Miscellaneous games

Except for the cribbage board in Fig. 8 and the traveling chess set in Fig. 10, all the other games we have picked to illustrate our article are of Catalin. The color of this material, the way in which it can be fabricated and its wearing qualities in applications of this sort popularize it with game manufacturers.

Nothing could be more conducive to play than the ivory and red hand-carved chessmen of Catalin shown in Fig. 1 and marketed by Metro Manufacturing Co. of New York City. And the same company uses cast phenolic again for the line of dominoes shown in Fig. 7. The company does the fabricating of the cast phenolic itself, slicing the dominoes from slabs, grooving, rolling to achieve desired polishing and painting in dots.

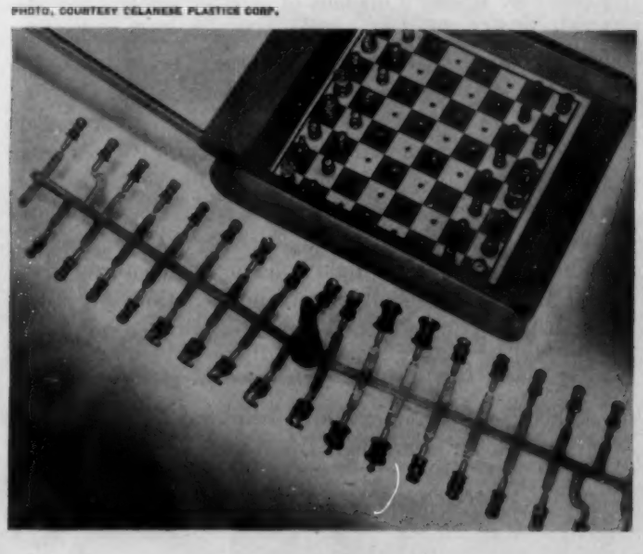
Again the appearance and feel of quality are achieved through the use of cast phenolic in the Mah Jong set in Fig. 6. A product of Arthur Popper, of New York City, it is a luxury item just like the combination backgammon, checkers, chess, cribbage, chuck-a-luck, roulette, poker, dice and chips, dominoes and spot dice set in Fig. 9 which is put out by E. S. Lowe Co., Inc. But this last set does not depend alone on cast phenolic. The roulette bowl is molded of Bakelite by Niagara Insul Bake Specialty Co., Inc., Albany, N. Y.; the chess are produced by Gallant Knight from Tenite; the chips are of Plaskon and the cups of Catalin. Ekloid Co. of Providence, R. I., supplies the dice while the Synthetic Plastics Corp. of New York City molds the plastic horses.

Not to be overlooked is the Metro Manufacturing Co.'s molded urea cribbage board or its traveling chess set with chessmen injection molded of Lumarith by Arrow Plastics Co. of Passaic, N. J.

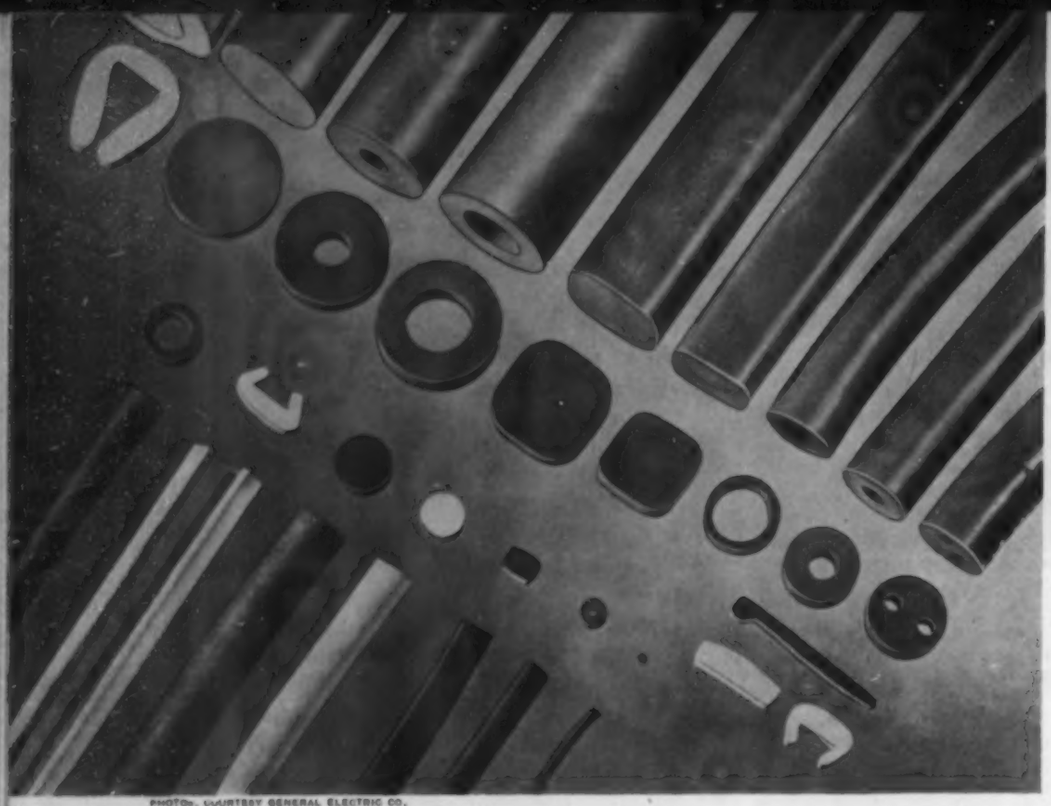
And it should not be forgotten that the adult game field is but a part of the whole game industry that had estimated manufacturing value of $9,343,133 in 1939.

9—Cast phenolic, urea, cellulose acetate and molded phenolic are found in this combination game set

PHOTO, COURTESY CELANESE PLASTICS CORP.



10—Adding to the light weight of this inexpensive traveling chess set are injection molded cellulose acetate chessmen



PHOTOS, COURTESY GENERAL ELECTRIC CO.

Samples of extruded tubes, rods and fabricated stock made out of silicone rubber are illustrated here

Uses and processing of silicone rubber

WHEN industry wants a material that will withstand a wide range of operating temperatures, it's a much better than even chance that silicones will be the final choice. Specially notable has been the growing acceptance of silicone rubber, the youngest of the silicone family, and much of this spread in application results from improved molding and fabricating techniques developed by the Chemical Dept. of General Electric Co. in Pittsfield, Mass., for its silicone rubber.

The nature of silicones

To those unfamiliar with the characteristics of the silicones, it might be advisable to mention briefly that they are derivatives of sand, brine, coal and petroleum, formed by taking a nucleus of sand or silicone dioxide and modifying it with organic chemicals. The silicones combine the toughness and usability of organic plastics and the heat stability of the inorganics. Their outstanding property is their ability to withstand higher operating temperatures than conventional phenolic resins and hydrocarbon rubbers. This they do to an extent that they remain practically unaffected when subjected to temperatures ranging from −55 to +520° F. In addition, they are highly chemical, moisture resistant, provide excellent electrical insulation, are nonvoltatile and do not adhere to metals or other materials.

Uses for silicone rubber in gaskets

Silicone rubber, in extruded form, was used primarily as gaskets for searchlights, superchargers and other electrical equipment during the war years. Today the material, in both the extruded and molded forms, is being more widely applied in those same fields and is finding comparatively extensive use in such other applications as aircraft, heat-sealing equipment, lighting equipment, baking ovens, diesel engines and also in vacuum systems.

In searchlights, G-E silicone rubber withstood continuous use at 340° F. as compared to a generally accepted maximum of 220° F. for most synthetic and natural rubber formulations. Severe tests in which silicone rubber aged for one year in a hot dry circulating oven did not appreciably change the surface hardness or flexibility of the material. At a temperature of 400° F. the silicone material remained flexible and resilient for several months; at 500° F. it remained that way for several days.

Silicone rubber parts are now being used in many large aircraft as gaskets in powerful new radial engine motors and in jet engines. It is also being incorporated in a new type of oil seal which operates around high speed shafts at temperatures of 350 to 400° F. The outstanding heat resistance of the material also suggests its use in hot air de-icing systems and other places in the planes where high temperatures are encountered.

In high vacuum systems, G-E silicone rubber is particularly applicable because no volatile components are given off at elevated temperatures simply because the silicones do not have any plasticizing oils in their formulations. The fact that they maintain uniform

surface hardness and flexibility over a wide range of temperatures is important as is the fact that there is less breakage of glass equipment occurring from expansion and contraction when silicone rubber is used between glass and metal at high temperatures. For this application, the silicone product also gives greater protection against leakage because stocks do not harden and less pressure is necessary with the softer stocks to obtain a good seal.

One of the increasing uses for silicone rubber is as gaskets for high temperature equipment such as diesel engines, gas turbines, air compressors and other equipment where natural and synthetic rubbers cannot withstand high operating temperatures and do not provide the low permanent set and nonadherence to metals. In a new diesel electric locomotive, silicone rubber gaskets are used between the supercharger and diesel engine block where a soft resilient stock is required to give positive gasketing action at 300° F. and 15 lb. air pressure. The heat resistance of the silicone material results in fewer replacements of gaskets and reduces time lost due to repairs.

Uses in press pads, lighting equipment, ovens

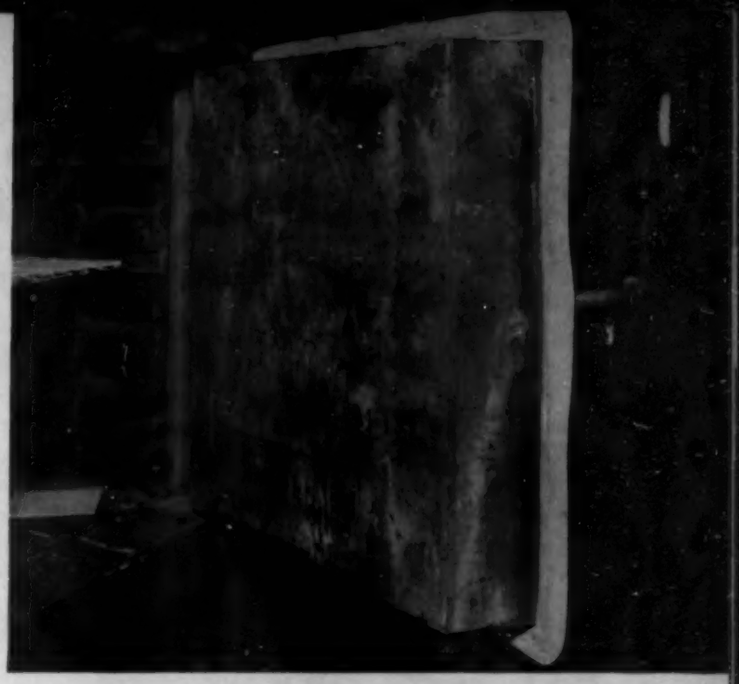
Another novel use of G-E silicone rubber is as a press pad in heat-sealing equipment where it stands continued exposure at 300 to 350°F. with no noticeable change in flexibility or surface hardness, and where it does not adhere to plastics, glass, cloth, metal and other materials used in packaging. A similar use is in pressing sheet mica where silicone rubber is laminated with layers of asbestos cloth to provide a pressing pad that insures an even bond over the entire sheet.

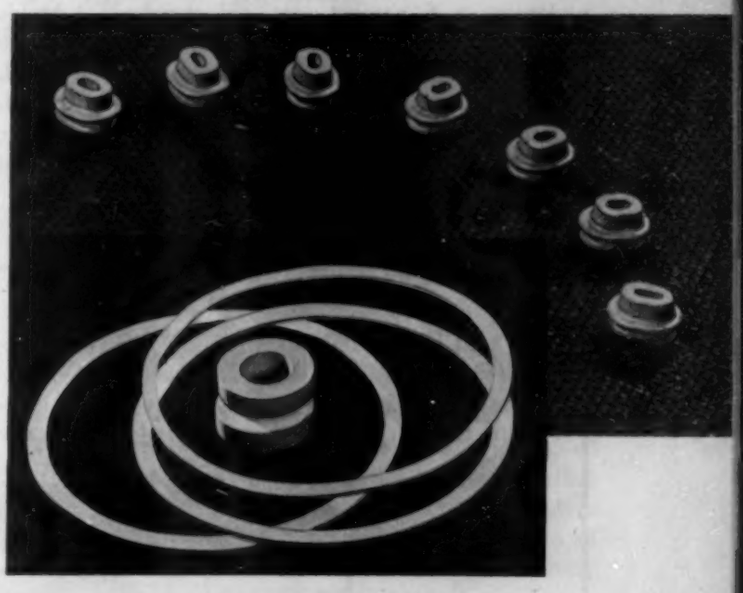
The silicone material is receiving additional use in the lighting field as gaskets for floodlights, searchlights, explosion-proof lamps, hospital operating lamps and infrared baking equipment. In such applications, the use of silicone rubber reduces possible breakage of the lens because of its flexibility at high temperatures and likewise reduces maintenance problems due to the fact that no volatile components which coat the lens are given off at high temperatures. Engineers state that silicone gaskets oftentimes eliminate expensive cooling vanes and other derives designed to reduce temperatures. High intensities do not promote surface oxidation and cracking, and when relatively high concentrations of ozone are present, stability is excellent.

For high temperature baking ovens, silicone rubber gaskets result in a less frequent shutdown of baking equipment, in less entry of air or leakage of hot air because of the uniformity of the material at varying temperatures, and in less necessity for close tolerances and accurate machining of large castings. The non-adhering properties of the silicone oil has been found to be advantageous for this use.

Available forms of silicone rubber

G-E silicone rubber is available in extruded shapes, molded parts, sheet stock or fabricated stocks. Extruded rubber is available in rods, tubes, flat strips or a





Silicone rubber is used in gaskets for high temperature oven (top) and as press pad in heat sealing equipment (center). At bottom are experimental gasket and valve seat for high temperature vacuum system. Above are grommets, molded from silicone rubber, used as insulated electrical leads on supercharger at 300 to 400° F.

variety of desired shapes for which a die may be formed. Sheet stock is available in thicknesses from 1/32 to 3/4 inch. It may also be reinforced with plies of glass and asbestos cloth. Molded parts can be made in any of the conventional types of compression molds and are now being produced in increasingly intricate shapes.

Handling and fabrication

Molding procedure for G-E silicone rubber is somewhat similar to that used in ordinary rubber processing. Molding temperatures are 140 to 160° C. but are not too critical due to long cure required. Mold time is from 2 to 10 min., depending on size of the piece and type of application. Molds are loaded and unloaded cold at temperatures not greater than 50°C. This necessitates cooling the mold while it is still in the press. *Gassing* is not necessary except in very large moldings (around 2 lb.).

Due to the steam heating and water cooling that is at present necessary, molding cycles may be as long as 20 minutes. Mold release compounds are unnecessary with the harder materials but a sulfonated oil type of release is recommended for the softer materials.

With flash-type molds, certain precautions should be taken in regard to the speed of the mold closure (which should be relatively low) and the molding pressure (which should not be in excess of 100 p.s.i.). Positive or semi-positive molds are more flexible in operation and can be used with molding pressures up to 500 p.s.i.

Final curing of the silicone rubber parts is accomplished at 200°C. for periods of 36 to 72 hours. During this process, the ultimate tensile strength and other physical properties are developed but the material undergoes a 6 percent sectional shrinkage. Molds should be designed to take the shrinkage factor into account. In many cases the parts are cured on shrink forms which maintain the overall dimensions required.

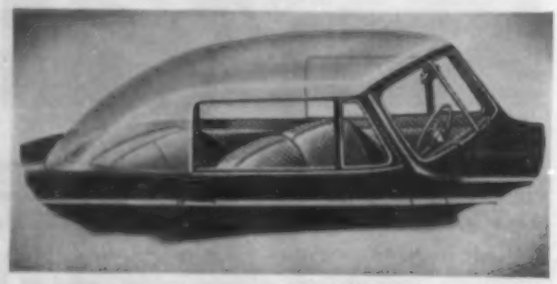
Although costs of the material are high at the moment, greater production is expected to reduce them substantially and broaden the uses of the material.

Average Properties of G. E. Silicone Rubber

G. E. No.	*12600*[a]	*12601*[b]	*12602*[c]	*12603*[d]
Specific gravity	1.75	2.04	1.40	1.50
Durometer, shore A	40	60	70	80
Compression set, % at 150° C.	30	45	35	30
Tensile, p.s.i.	200	450	650	500
Elongation, %	225	150	110	100
Tear, lb./in.	35	45	45	35
Dielectric strength, s/s	300	260	385	400
V.p.m. at 25° C., s/t	325	285	450	450
Dielectric strength, s/s	305	255	510	385
V.p.m. at 100° C., s/t	350	330	560	505
Dielectric strength, s/s	400	335	620	505
V.p.m. at 150° C., s/t	345	345	680	505
Power factor, 1 mc, dry	0.00075	0.00045	0.0030	0.0037
Power factor, 1 mc after 3 days wet	0.0105	0.0175	0.0045	0.008
Power factor, 1 mc after 7 days wet	0.0142	0.0182	0.0045	0.0082
Power factor, 1 mc after 14 days wet	0.0160	0.0179	0.00475	0.0085
Power factor, 30 mc, dry	0.00310	High	0.00475	0.00735
Dielectric constant, 1 mc, dry	3.8	7.4	3.25	3.45
Dielectric constant, 1 mc after 3 days wet	4.40	10.10	3.25	3.60
Dielectric constant, 1 mc after 7 days wet	4.45	11.30	3.25	3.60
Dielectric constant, 1 mc after 14 days wet	4.90	10.70	3.20	3.70
Dielectric constant, 30 mc, dry	7.60	High	5.20	5.80
Loss factor, 1 mc, dry	0.00285	0.00333	0.00975	0.01278
Volume resistivity, megohms/cu. cm.	1.5×10^5	1.5×10^5	1.5×10^5	1.5×10^5
Water absorption at 25° C. (7 days)	2.4%	0.64%	0.66%	0.54%
Water absorption at 100° C. (7 days)	7.1%	6.8%	3.2%	3.0%
Forms available				

[a] Extruded.
[b] Molded.
[c] Extruded and molded.
[d] Extruded and molded.

A FULL-VISION PLASTIC TOP FOR CONvertibles, just put on the market by Wright-Austin, Detroit, Mich., is bound to win enthusiastic followers among those who enjoy seeing the countryside at all times regardless of rain, snow or gusty winds. The Plexi-Top, formed in one piece of 1/4 in. thick Plexiglas, (so as not even to have obstructing seams) is supplied clear or in transparent tints of red, green and blue.



One of the special features of the acrylic top is its installation, which is quick and easy—fastening only at 4 points without the aid of tools. It does not necessitate removal, only lowering, of the regular top which it covers and protects. A rubber gasket effects a tight seal between top and body, eliminates rattling. Plexi-Tops are currently available for Ford and Mercury cars—models for other makes are promised.

Motor for the brush is held between the ethyl cellulose brush cover and butyrate brush back. General purpose phenolic and cotton flock filled phenolic are used for motor base, frame

Massaging scalp and grooming the hair are accomplished mechanically by this brush having an electric motor to rotate the bristles and the brush back in a gyratory action

Six uses for plastic in an electric brush

Ethyl cellulose, butyrate, two types of phenolic, nylon and vinyl resin combine in this hair brush

A HAIR brush must be tough, long wearing and good looking. If it is an electrically driven rotary-action brush like the newly introduced unit pictured above, it must have the additional qualities of thermal and dimensional stability.

To achieve all these qualities in the Gyra electric hair brush, six different plastics are used—a different material to meet the specific requirements of each of the six plastic parts. Thus, the ethyl cellulose Celcon was picked for the brush cover to insure the desired dimensional stability and toughness. For the brush back, Tenite II was selected since it was believed to possess fabricating characteristics and stability required in brush making. The motor base is made of Bakelite's general purpose phenolic to provide thermal and age stability and to accommodate inserts. A cotton flock phenolic compound, also by Bakelite, is used for the motor frame, again for thermal and age stability plus strength. To this list must be added the nylon bristles and the vinyl insulation which is used for covering the electric cord.

All the plastic pieces and the molds were designed by Shaw Insulator Company, Irvington, N. J., the firm that does the molding and finishing. The ethyl cellulose cover and the cellulose acetate butyrate brush back are both injection molded. The other two molded parts—the motor base and the motor bracket or frame—are compression molded. Only the conventional finishing work is required on all these four plastic parts. However, the ethyl cellulose cover requires a double buffing to bring out its luster. The gold leaf design on the cover is applied by the Acromark process.

A new approach to hair conditioning

The operation of this new hair brush design is based on the belief that gyratory action of the bristles, that is, high-speed rotary action, produces a more effective massage and stimulates the superficial circulation of the scalp to a greater degree than can the ordinary slower back-and-forth method of vibration.

There are no switches on this Gyra brush. To start it running it is only necessary to plug the cord into any electric outlet. Then, with the brush held with the bristles facing downward, a flick of the wrist to turn the bristles upward will set the motor in operation. To stop, just pull the plug from the socket.

PHOTO, COURTESY COHAN-EPNER CO., INC.

PHOTO, COURTESY PROCESS INSTRUMENTS CO.

Left—All types of plastic items can be metal coated—even those with intricate designs. Peeling in front of the bracelet at left shows thickness of coating for that piece. Right—Here are metallized vinyl chloride sheet (top left), metallized plastic dust (in tube) and coated acetate transfer sheet (lower left)

Metal coated plastics

AN INDUSTRIAL designer, working on new designs and production plans for a toy battery-operated telegraph set, was faced with the problem of cutting down assembly costs. In the base of the set were a number of metal strip connections which allowed the operator to produce either a click or a buzz, or to flash a light by turning a switch. These separate metal strips had to be fastened in place by hand. The designer figured that if this work could be cut down, the savings in labor costs would be considerable.

The solution to the problem was simple. The designer just applied like-shaped strips of silver-conductive paint to a sheet of rigid but thin plastic and snapped the whole sheet into the assembly, utilizing the electrical conductivity of the metal application and the insulating properties of the sheet.

Newest application of metal to plastics is a radio chassis being developed by Promenette Radio & Television Corp., of Buffalo, N. Y., in which the metal connections are sprayed on the plastic housing in one operation. The sprayed metal forms strips about $^1/_{10}$ in. wide and $^1/_{1000}$ in. thick, eliminating the need of a soldering iron in radio assembly.

After all component parts have been set in the plastic housing, it is covered with a mask from which strips are cut where connections are to be made. The housing is then placed in a sand blaster which marks out the channels. Then molten metal is sprayed into the sandblaster channels where it provides all the connections.

This, of course, represents only a minor application of metal coating on plastic materials. It is mentioned here simply to focus attention on some of the new and relatively little known, yet very effective, phases of the business.

There are three ways of applying films of metal to plastic surfaces:

1. In a vacuum and under high heat, metal can be caused to disintegrate and fall like dew on both the plastic item and the interior of the vacuum chamber.

2. A shiny metallic spray can be applied to the plastic by air pressure, putting a microscopic film of metal on the surface.

3. A coating of silver can be painted or screen printed on to a plastic surface. This silver deposit acts as an electrical conductor for the applying of metal plating on top of it.

The first two types of metal coating are generally lacquered when the use is to be decorative. The paint coating, the new method described in paragraph 3, can also be used as a decorative finish with lacquer on top; or it can be used as a base for plating. Actually, this is not one silver paint, but a series—one for each type of plastic, with solvents of each particular material present in each formulation.

Reasons for metal coating

There are many uses for metal covered plastics in which advantage is taken of the conductivity of metal and insulating properties of plastics. These are to be found in the radio field, in electrical analyzing equipment and in electronic sound transmission.

In another category are the new airplanes on transcontinental and over-ocean flights which use plated plastic mirrors both for decorative and functional purposes. These same sheets of metal-coated acrylic are used as well for fancy boxes, novelties and ornaments for gift sale. In both types of application the light weight of the plastic, its resistance to impact and abrasion and its light-reflection qualities are important. In some instances both light-reflection and transparency are used to advantage in colored sheet material since it is possible to put coatings of silver, copper or gold on a sheet of colored transparent plastic in such a way that you can see through it in one light but will get a reflection from it under another light if the sheet is placed against an opaque background. Thin material so handled is useful for sequins, millinery decorations, etc.

It has also been found that metal coating on plastic materials will carry heat across an area, thus improving the heat resistance of the plastic and even its dimensional stability under conditions of high heat.

Still another category of general applications is dependent on the fact that when metal is applied to plastics the corrosion resistance of the metal is improved. It has been shown that a plastic base renders a metal coating much less susceptible to corrosion than does a metal base, especially iron or steel. Now, molds for low-pressure molding are being produced by plating a model; then backing up the plating with metal or plastics.

Plating is a specialized work

Today, the business of metal plating or metal coating plastics is highly specialized work, having become more so during the past two years while new methods were being developed for application of metal to new plastic materials. Each method has its own uses, advantages and limitations. Not only is there a considerable difference in cost between the methods but they differ in their work—some working on some materials but not on others. (*Please turn to next page*)

A star-shaped dress ornament is covered with sequins cut from metal coated plastic sheet 0.005 in. thick

PHOTO, COURTESY FLEXMIR INC.

PHOTO, COURTESY INTER-STATE PRODUCTS CO.

Plastic based jewelry and buttons are metal coated by sputtering or spraying. It is possible to further decorate these pieces by applying colored enamels on top of metal coatings

In spite of the fact that cellulose nitrate was coated with metal fully 35 years ago and that phenolics have been metal coated for at least 28 years, the business remains today as much of an art as it is a science.[1] It is a good idea for the prospective buyer of plastic plating to put his problem in the hands of a reliable plater or coater who can best determine, from an analysis of the intended uses of the finished product, what method should be used. Literally any plastic material, from a patent-finished vinyl flexible sheet through the range of molded and cast plastics to chip and dust particles can be plated or coated.

The plater or coater has to know the basic chemical structure of the plastic to be metallized, must know the plasticizer used (if any) and its possibilities of migration. He must also know the porosity of the plastic, its chemical and physical resistances and its electrical properties. Finally, he must be acquainted with the uses to which the product will be put.

What is being done in the field

Here are some examples of the work that is being done in this field, taken from current production of some of the leading metallizers:[2]

Metalplast Co., New York City, one of the oldest concerns in the field, performs plating services itself and in addition provides a variety of metallizing services to the plastics industry by authorizing other people to use its patented methods under license. The Metalplast Co. and E. I. du Pont de Nemours & Co., Inc., Arlington, N. J., jointly developed the silver conductive paint mentioned above and Metalplast now merchandises the process as well as the paint.

Flexmir, Inc., is one of the pioneers in the specialized field of applying metallic coatings in a wide variety of finishes. The company makes mirrors on Lucite and Plexiglas. Combining color finishes and metal finishes on acetate sheets and rolls, it produces a product used extensively for decorative purposes and as sequins.

[1] A complete and detailed description of the methods used will be found in MODERN PLASTICS ENCYCLOPEDIA for 1946, pages 849–852.

[2] A complete directory of the companies in the business will be found in the 1946 MODERN PLASTICS ENCYCLOPEDIA.

A subsidiary of Flexmir, Inc., Newark, N. J., Plastics Finishing Co., Inc., uses the Flexmir method to produce gold and silver metallized buttons and jewelry novelties on plastic and wood pulp materials.

G.M.C. Process Corp., New York City, using Plexiglas, Lucite and specially cured acetate, is manufacturing components for dresser sets, compacts, vanity dishes, etc., by means of electro-deposition of silver in an alkali bath, the finishing being accomplished by baking. This company has also successfully applied precious metals to molded nylon. It specializes in complicated design plating.

Electro deposit of metals on plastics, especially acrylics, is done by Haro Products, Inc., New York City, as a service to manufacturers of handbag handles, compacts, cigarette cases, novelties and gift ware. Much of the company's work is pattern metallized.

Jewelry and novelty components as well as plastic style articles are being electroplated by Plastiplate Co., South River, N. J. This firm is developing services for makers of electronic and industrial units.

Process & Instruments Co., of Brooklyn, N. Y., uses vacuum evaporation of metal to put 24 karat gold on flexible vinyl for the manufacture of handbags; aluminum and copper on Plexiglas to form optical quality mirrors; gold and silver transfers on acetate for bookbinding decorations, in which a hot stamp causes the metal to pass from the plastic sheet to the bookbinding; and to metallize buttons, bottle caps, jewelry and novelties on cast and molded plastics.

Cohan-Epner Co., Inc., New York City, another old company in the field, uses a plating method exclusively to apply metal to cast and molded pieces, to parts of extremely intricate design for use as jewelry items, auto decorations and electrical parts.

Inter-State Products Co., of New York City, specializes in spray metallic coatings (baked on) in a wide variety of finishes. Concentrating chiefly on jewelry, the company combines color finishes and metal finishes, sputtering and lacquering with metal, handling thin sheets of rigid plastic 20 by 50 in. in size.

A PRODUCTION SPEED OF 1000 CARDS per hour is claimed with this streamlined plastic duplicator offered by the Rutherford Duplicator Co. The phenolic one-piece housing is compression molded by Molded Products Corp. of Chicago, Ill., in a semi-automatic press at a hydraulic pressure of 125 tons. The raw material, Bakelite #6260 black, is preformed and preheated before being placed in the 1-cavity mold. Approximately 460 grams of material are used to produce each housing and the curing cycle is $2^1/_4$ minutes.

Plastic was selected by the company for its attractive appearance, permanent finish, sturdiness and its ability to provide a streamlined housing which is so much in demand today.

Molded housing for electric manicurer

White or red cellulose acetate is used for the two-piece housing of this home manicuring set

GOOD looks, ease of operation and a minimum of maintenance are the three elements that women want in products like this electric home manicuring set which was brought on the market this fall by Erie, Inc. The success of the "Matthews electric nail styler" in meeting these conditions is due, at least in part, to the use of plastics for the housing. Thanks to plastics the case is compact, streamlined, colorful and, consequently, easy to grip, of a pleasing texture and easy to clean.

A cellulose acetate housing

In contrast to most electric razor housings, which this unit closely resembles, the case for this manicure set is injection molded of white or Chinese red Tenite, not compression molded of a thermosetting material. Another departure from the usual lies in the fact that the two parts that comprise each molded housing are not identical, one half having an opening near the head for the motor shaft.

The real trick in producing the two parts, which are turned out in a four-cavity mold, lies in the proper handling of the brass inserts (seven to a case) to eliminate shrink marks. It is by these inserts that the small electric motor, which causes the operating arm to vibrate approximately 6000 times per minute, is held firm inside the cellulose acetate case.

Besides the outer housing, the Quinn-Berry Corp., Erie, Pa., produces a number of other small plastic parts for this set. The emery and buffing attachments, for instance, are molded in an 18-cavity die. The emery cloth and the felt, however, are not assembled by the molder but by the manufacturer along with all the other assembly operations. It is expected that this work will all be done by electrically powered screw drivers once full production has gotten under way.

Besides the plastic housing, the electric motor, the file, buffer and cuticle roller, there is the chrome-plated head piece which is stamped out on a punch press and fashioned in hand-forming fixtures. A special test box, employing electronic controls, is used in a final inspection for short circuits and unnecessary noise, and for a check on the speed of the motor.

Feminine hands can be manicured with this electrically operated unit that has buffer, file and cuticle roller attachments. The housing, resembling those used on electric shavers, is easily gripped and manipulated

A real time-saver

This so-called electric nail styler is the idea of John C. Lesher and was developed by him and Seymour Matthews of Erie, Inc. Wieghing but 6 oz. and being less than 6 in. long the unit presents no space problems —being easy to tuck away even in a woman's usually overcrowded traveling case. And it is well worth what space it does take up for it cuts manicuring time in half. Using this device a thorough manicuring job can be over and done with in from 12 to 15 minutes. And it can be accomplished almost anywhere for the motor operates on either AC or DC current.

So favorable has been the initial response to this electric manicurer that the manufacturer expected a production of 50,000 units this fall with the possibility the next year's output may be stepped up to as much as 250,000 units. As a supplement to the manufacture of new units, the company is planning facilities for the reconditioning of worn machines for a nominal fee.

Mesh reinforced plastic has many uses

by FRANK C. WILLIAMS*

THERE are two forms of the mesh reinforced plastic, Vimlite—one that employs wire mesh and another that is based on plastic mesh. The wire mesh product finds its principal outlet in agricultural uses while the cellulose acetate coated plastic mesh is best adapted for industry, business and the home.

Plastic coated materials are not new, of course. They date back to the 1880's when cellulose nitrate dopes were applied to paper to cover glider wings. Later, these same dopes were applied to fabrics for airplane wings. During World War I, the Drs. Henry and Camille Dreyfus developed a cellulose acetate dope for airplane wings which, because of its non-flammability, reduced the dangers from German incendiary bullets. Subsequent developments have included such other forms of covering as lamination of continuous length plastic films over cotton scrim and wide mesh wire.

The development of the Vimlite type plastic materials followed very closely the announcement of the first cellulose acetate plastics by direct outcome of the early experiments with safety motion picture film and the development work of Dreyfus in dope and yarns and fabrics. At first only the wire mesh type was available; the plastic mesh Vimlite came later.

* Director of Sales, Vimlite Dept., Celanese Plastics Co., New York 16, N. Y.

Agriculture and animal husbandry

Acetate dopes have a number of properties that have particular appeal for the agricultural field. These include excellent transparency, invisible ray transmission and high film strength. Applied as a glazing material, as on wire mesh, they give livestock the benefit of added vitamins from the sun since they allow transmission of ultraviolet and infrared rays, something that is untrue of ordinary window glass. Further, the wire mesh Vimlite is unbreakable and retains the heat.

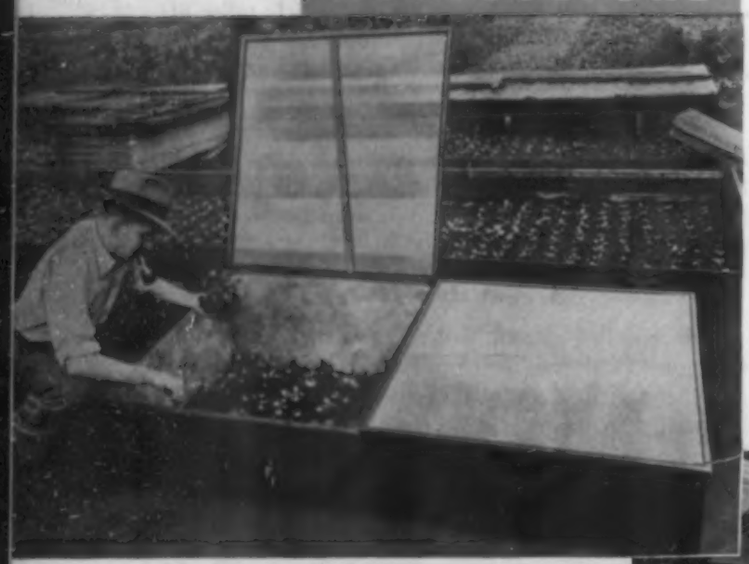
War applications

It was natural that technical advances in the plastic field should produce a strong plastic filament and that this would be woven into a wide mesh cloth. Continuous research for better types of mesh reinforced plastic and the contemporary shortage of wire mesh naturally suggested the plastic mesh reinforcing material. Started during the second World War as a glazing for Army barracks, hospitals and other Army installations in the tropics where wire could not stand up to the high moisture corrosion and heat conditions, plastic mesh Vimlite has also proved most adaptable to peacetime uses.

Industrial application

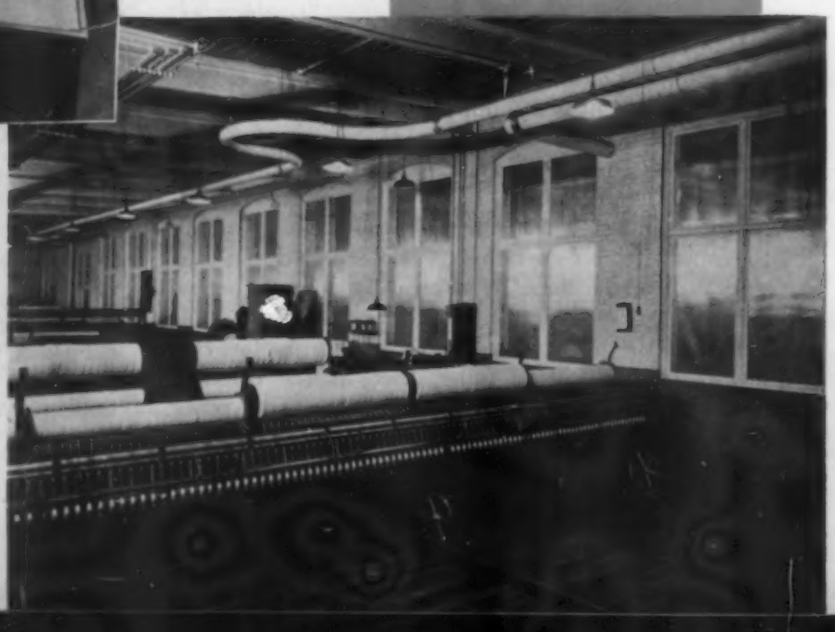
Partitions—With a total light transmission of 83 percent, a high ultraviolet and infrared ray transmission

AGRICULTURE



Above—Cold frames glazed with wire mesh reinforced plastic admit ultraviolet light yet act as an insulator

INDUSTRY



Right—Constant temperature and humidity are maintained in a factory having plastic mesh reinforced windows that neither shatter nor vibrate

value, great strength, flexibility and pleasing appearance, cellulose acetate coated plastic mesh has proved itself particularly effective as partition material. Easily erected on a very light wooden frame, it can be used to advantage to separate machines and processes adjacent to each other where the possibility of contamination by flying particles costs manufacturers excessive spoilage losses. For instance, in a yarn mill where raw wool or cotton is converted on huge 80-ft. long machines into finished yarns, two colors on adjacent machines are subjected to contamination through the *fly* being carried from one machine to the next. Vibration of the machines prohibits the use of glass and in many cases the additional floor load obviates its use. The tough, light, easily erected mesh reinforced plastic partitions effectively separate these machines with a non-flammable ight transmitting wall.

Stock rooms—Factory stock rooms, often placed where airborne dirt accumulates, can be effectively sealed in by simply stapling plastic mesh Vimlite to the existing framing.

Air conditioning—Single processes or rooms can be effectively air conditioned by building cellulose acetate coated plastic mesh enclosures around them or covering the walls with this flexible material. The material can also be used in place of glass in factory and likewise in office windows.

Home furnishings

In more refined form, effective light control by means of translucent window coverings is now available in the form of roller shades made with plastic mesh Vimlite, coated with either clear or colored acetate. The shade can be varied from the simple glare elimination screen to one that is absolutely opaque. Of special interest is that the shades are virtually fadeproof, tearproof and non-flammable.

Tinted with pleasant pastel colors, plastic mesh Vimlite can be fashioned into lamp shades, table mats, luggage covering and wall covering where its high abrasion resistance lends added ut lity. Window ventilators which admit light but eliminate drafts, dust,

HOME FURNISHINGS

ALL PHOTOS, COURTESY CELANESE PLASTICS CORP.

Top—Plastic mesh is used as the base in table mats which resemble linen, are waterproof and heat resistant. Above—Window shades of same material are cleaned with a damp cloth

BUSINESS

Left—Translucent panels of cellulose acetate coated mesh partition stockroom without obstructing the light

rain and snow have been successfully marketed over the past two years.

Continued research

To add to the products mentioned above, this type material is being adapted to new uses every day by ingenious Americans eager to do things in a new and better way. The laboratories are constantly engaged in evaluating new uses and are glad to offer their services to give practical information and instructive criticism on any new ideas submitted to them regarding their material.

Thermosetting silicone resins

A COMPLETE revision of the preliminary data sheet on DC 2103, Dow Corning Corporation's thermosetting silicone resin, now in commercial production, has recently been issued.

DC 2103 is the thermosetting resin developed and produced for use as a heat-stable bonding material for inorganic fabrics in the production of rigid electrical laminates; and for bonding finely divided particles such as powdered metals or mica, silica or carbon. It is an organo-silicon polymer material built on an inorganic skeleton of alternate silicon and oxygen atoms. Its unique properties are due largely to the inherent stability of this inorganic skeleton.

The properties which may be expected of laminates bonded with this resin or of articles molded of DC 2103 bonded particles will vary considerably depending upon the kind and type of filler used.

The chemical resistance of this resin to all commonly used inorganic reagents except concentrated sulfuric acid and, to a lesser extent, concentrated nitric acid is good. It has limited resistance to organic solvents, being unaffected by the lower aliphatic alcohols and mineral oil, slightly affected by glacial acetic acid, and strongly affected by chlorinated solvents, ketones, esters, light naphthas and aromatics.

Table I.—Physical Properties of Unfilled DC 2103

Specific gravity, at 25° C.	1.265
Refractive index, at 25° C.	1.47 to 1.49
Coefficient of linear expansion (0 to 100° C.)	15×10^{-5}
Moisture absorption (A.S.T.M. D-570), percent	0.05 to 0.20
Dielectric strength, volts per mil	
(A.S.T.M. D-149) short time dry	500
(A.S.T.M. D-149) short time wet	450
Dielectric constant (A.S.T.M. D-150)	
Dry at 100 cycles	2.86
Wet at 100 cycles	3.01
Dry at 1 megacycle	2.88
Wet at 1 megacycle	2.96
Power factor (A.S.T.M. D-150)	
Dry at 100 cycles	0.00192
Wet at 100 cycles	0.00197
Dry at 1 megacycle	0.00158
Wet at 1 megacycle	0.00393
Loss factor	
Dry at 100 cycles	0.0055
Wet at 100 cycles	0.0059
Dry at 1 megacycle	0.1146
Wet at 1 megacycle	0.0116

Use of the resin to bond inorganic fabrics of asbestos or glass results in rigid laminations ideally suited for many electrical applications. Procedures for laminating vary somewhat and the properties of the lamination vary considerably depending upon the kind and type of inorganic material used. In any case, a catalyst is added to accelerate the setting of the resin. The catalyst recommended for use with DC 2103 is triethanolamine.

After the organic sizing has been completely removed either by heat cleaning or washing, the glass cloth may be silicone sized by dipping in a solution of DC 200 elastomer in an aromatic naphtha such as Solvesso 2. A pick-up of not more than 2 percent of this silicone sizing is recommended. In general, this silicone sizing improves the electrical properties of the lamination but it may somewhat reduce the physical strength of the laminates.

Molding—Best results are obtained if the condensation reaction of the DC 2103 polymers takes place under pressure during the molding operation. It is recommended that silicone-glass laminations be molded under a pressure of 1000 p.s.i. for 1 hr. at 175° C. (374° F.). A parting sheet of cellophane or aluminum foil should be used to prevent the adherence of the laminate to the platens and to give a good polished surface to the lamination. The press should be cooled before removing the lamination.

Because of its exceptional heat stability, waterproofness and excellent dielectric properties, the resin has many uses other than as a bonding resin for inorganic fabrics in the production of rigid electrical laminations. For example, it can be used as the resin binder in the production of a heat stable and waterproof basing cement for sealing light bulbs or radio transmitting tubes to metal bases. It can also be used for bonding finely divided particles such as powdered metals, carbon, Carborundum, silica, asbestos or mica in the fabrication of a wide variety of products including friction-producing materials, abrasive compositions and electrical resisters. In these applications, the type of filler used and the use for which the molded part is designed determine to a large extent the production techniques. There is such a wide divergence of materials and uses that only a few general recommendations can be made.

To facilitate inquiries, the addresses of all the companies mentioned on the following eight Plastics Products pages are listed on page 220 of this issue

Plastics Products

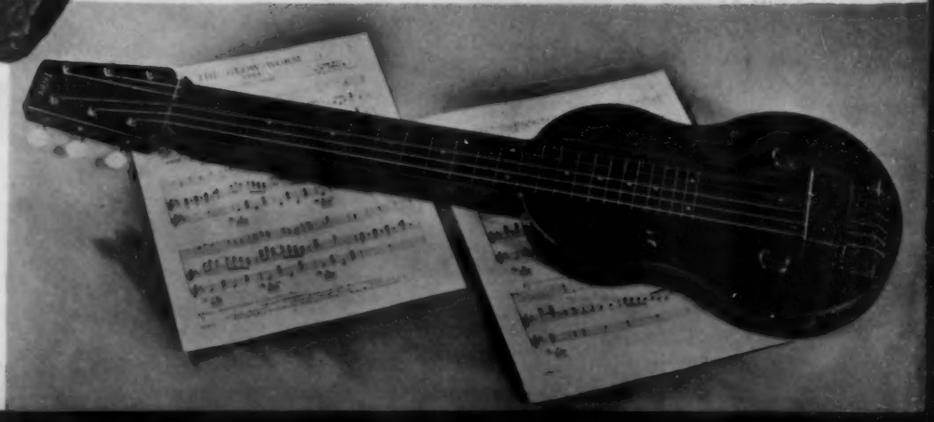
Joy riding becomes a reality in a 1947 car which is upholstered in Saran. The fabric, furnished the Chrysler Corp. by American Fibre Co., is well adapted to open cars because it resists sun and rain

Promenader—a dress-up leash for discriminating dogs. Tenite II, in various colors, is used in housing which is being molded by Chicago Die Mold Corp. for Inventors Products Corp. Leash is made of Saran

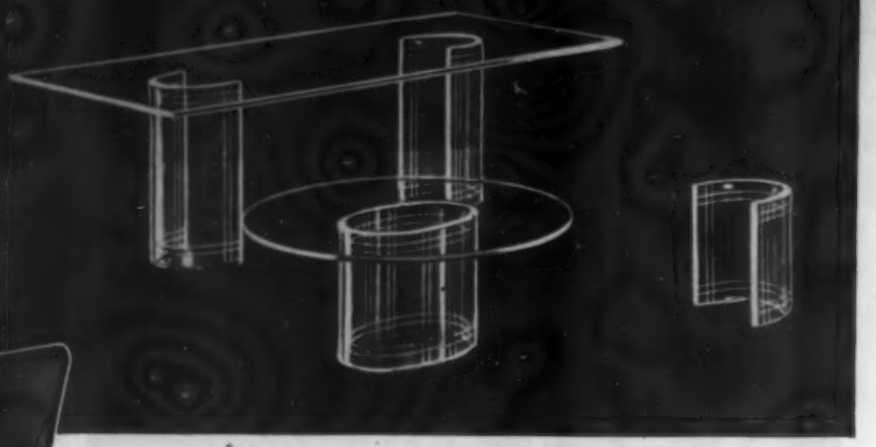
Leisure-time Accessories

The Sentinel Radio Corp. has picked alabaster, onyx and oxblood as the colors for this Catalin-housed radio. Rough castings are made by Catalin Corp.; the knobs, fabricated from the rod stock, are furnished by Unique Plastics Corp. Finishing and assembling is done by Franklinville Industries

Music hath added charms when played on this electric guitar compression molded of Resinox by F. E. Reinhold for Continental Music Co. L. C. Kiesel Co. did the designing



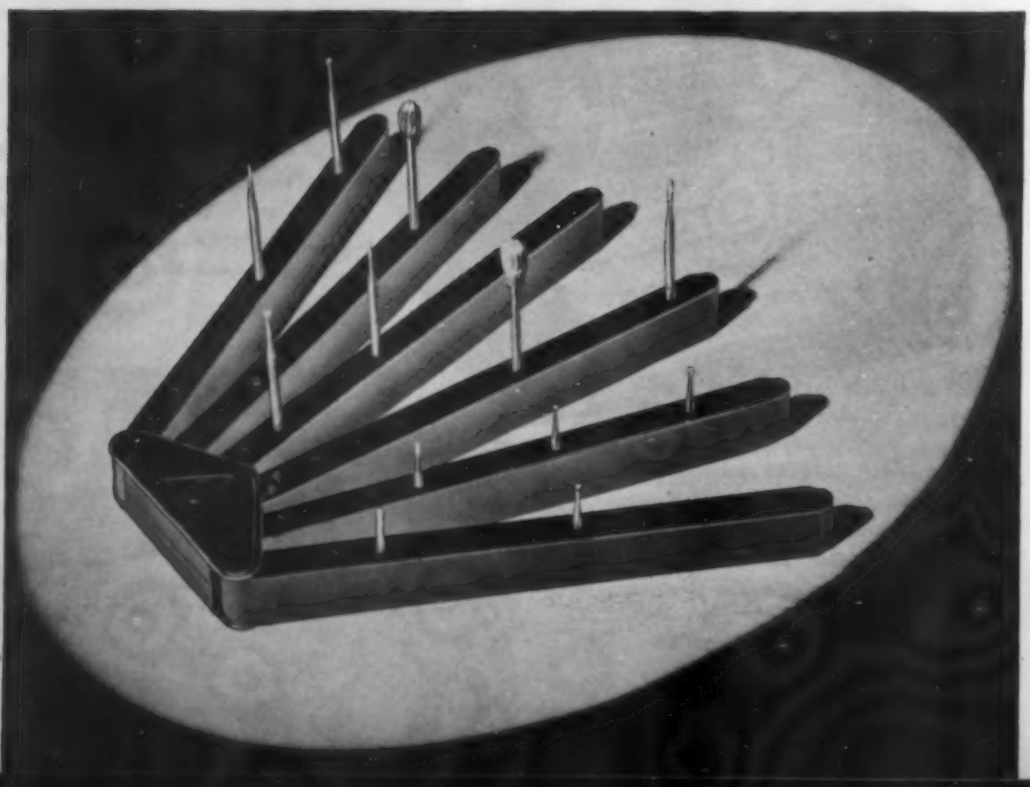
Wrong numbers? Not with Tel-Eze index. Condor Plastics Corp. molds the two-piece parts of the index of black Chemaco cellulose acetate for LeShore Corp. Extruded acetate bars are glued to the bottom of the index's interior to firmly hold the many cards in place



Merchandise of many descriptions may be effectively and attractively exhibited on units such as these. Modern Displays fabricates the simple-to-assemble pieces of Lucite and recommends them particularly for displaying bracelets. Semi-circular legs of these displays are furnished in different lengths so that the height of the display can be controlled by the legs that are used

BUSINESS

At the command of "Open wide!" your dentist probably reaches for a grinding burr. And he may well be reaching toward a free-swinging, 6-arm Lustron holder, injection molded by Plastic Artisans, which stores 72 burrs. Chayes Dental Instrument Corp. switched from metal to plastic to speed assembly and eliminate machining



The full addresses of companies mentioned on these eight Plastics Products pages are listed on page 220

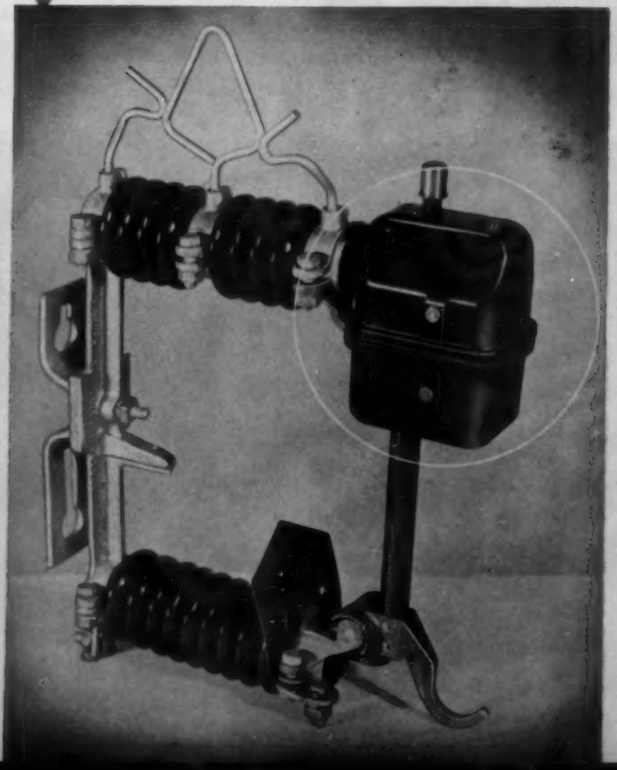
An electronically welded Vinylite mitten liner gives protection to wearers of Fried Ostermann Co.'s Soakproof mittens. Inasmuch as no stitches are employed for this die-cut liner, developed and engineered by Clarvan Corp., the mitten is absolutely airtight and waterproof. Sewed between the inner lining and outer shell, the flexible plastic is soft as silk and extremely strong

The latest outlet for translucent melamine laminates is in production of window displays and counter easels using decorative prints and patterns. Fabricon Products, Inc., manufactures panel, called Penrok, using Melmac to impregnate lay up which consists of over-lay sheet, print and a backing of enough translucent paper to give desired thickness

AND INDUSTRY

With efficiency the keystone of industry, businessmen turn naturally to ash trays which are always clean. The Fordman Co.'s 2-piece ash tray with its mushroom valve which allows ashes and stubs to disappear is compression molded of phenolic by Wayne Plastic Products. Colors include light oak, briar, walnut and mahogany

Plastics have reached the powerlines in this fuseless circuit breaker, protected against weather and insects by a Resinox housing. Chemical inertness, mechanical strength and good insulating qualities contributed to use of phenolic for housing, molded by T. J. White Plastics Co. for W. N. Matthews Corp.



HOME FURNISHINGS

A finishing touch to lamps of all descriptions, these finials are a good item to keep in the house. They are suited to bedroom as well as living room lamps because their simple design blends with any type lamp. William Herst Co. supplies the polystyrene and acetate finials in many colors but finds there is a better market for the transparent ones which resemble crystal

A guiding light to the sandman and a warning to the boogeyman, Rochelle Gifts' Kidi-Nite-Lite is a charming accessory for a child's room. The plaque, which can be made of Lucite or Plexiglas, fits in a slot in the colored metal base. Base also holds the bulb which edge lights the acrylic, causing the design on the acrylic to glow softly. The frosted effect of the pussycat figure is accomplished by a method of sand-blasting the acrylic

Brilliantly dyed trout flies inspire nostalgic memories and add a gay touch of color to these attractive coasters, fabricated from sheet Lucite by Warner-Wright, Inc., and marketed with the holder by Sun Glo Studios

Under-the-sea-enchantment and a flower are engraved in this Lucite or Plexiglas paper weight and light by a flexible shaft machine using special drills. Hypodermic needle introduces color. Lee Plastics is the fabricato

The addresses of companies mentioned on these Plastics Products pages are listed on page 220

A twist of the top...and out pops a cigarette through a slot in the side of the body. The transparent styrene used for all 3 parts—namely, the lid, case and rotor—allows visibility of the contents and enhances the beauty of this case. The lid is made with 3 nibs which engage the top of the rotor so it can be turned to eject a cigarette. Amos Molded Plastics is molding item for Tippecanoe Novelty Corp.

Taking it easy in a chair upholstered in Naugahyde is a pleasure that most anyone would look forward to. The vinyl material is supplied in a wide variety of colors, plain or mottled, to harmonize or match the color scheme of any room. Sturdy yet pliable, the fabric can be tailored with ease and it will also support tacks without tearing. Home owners will appreciate its long wearing and stain resisting qualities as well as a resistance to cracking and peeling

Pretty as the picture it displays, is this Adjusto frame made of plastic parts, attached by springs which permit adjustment in size. Cellulose acetate or butyrate are used by Barrett Plastic Products, Inc., for injection molded frame

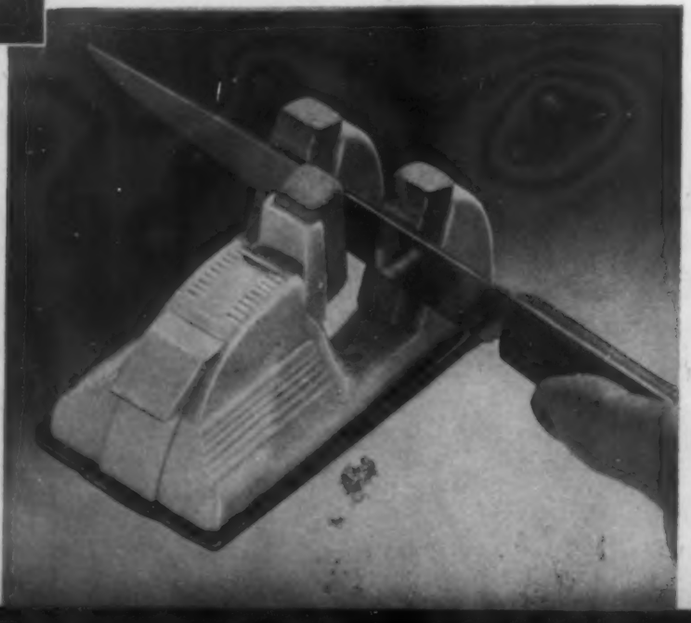
This attractive molded plywood coffee table is made up by Lewisburg Chair & Furniture Co. from birch and maple veneers that are bonded with urea resin

Kitchen Equipment

The addresses of companies mentioned on these pages are listed on page 220

Women spend 5 out of 24 hours in the kitchen. No wonder they want it attractive. Harte & Co. makes prettying-up-the-kitchen a pleasant job by supplying curtains, tablecloths, bowl covers, shelving and aprons in their washable and non-flamable Wataseal material

For a clean sweep, the Hollywood Star table crumb sweeper will do the job. Urea and phenolic are used by Peerless Plastics in molding the housing for Berger & Associates. Rotating brush bristles pick up crumbs. The unit is supplied in two tones of red, sapphire, onyx, orchid



Your dullest knives take on new life and become fine pieces of razor-sharp cutlery with this streamlined knife sharpener. Erie Plastics Co. injection molds the 2-part ivory body and China red base of durable light Tenite for Superedge Products, Inc., the manufacturers

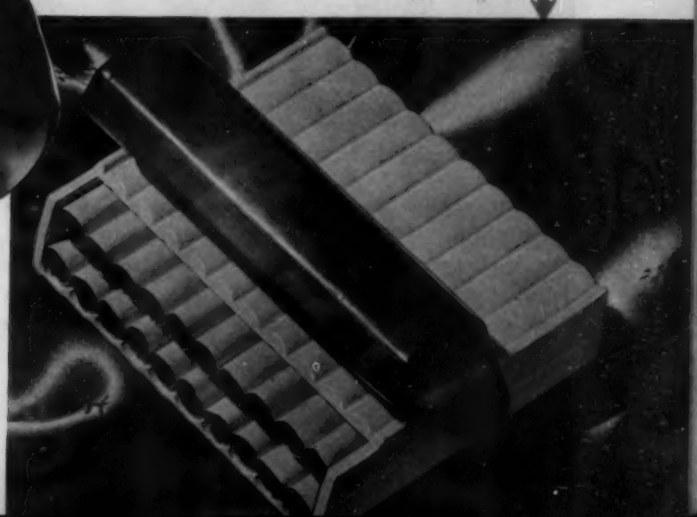
Getting a fresh start in the kitchen, or any other room, is but a matter of minutes with an Aeropal ventilator. White Beetle, used in the 12 by 12 in. housing is durable, easy to clean, strong. Michigan Molded Products makes the housing for American Blower Co.

Margy Maid mixes malted milks, churns butter, whips cream, colors margarine and performs a host of kitchen duties. The polystyrene top cover, bottom cover and box are injection molded in a 3-cavity die at one shot, cover bosses being molded in. American Molding Co. produces parts for Floyd T. Lovens, Inc.

PERSONAL ACCESSORIES

Joining the winter fashion parade are 2 of Josef's handbags which lavishly display plastics. Lumarith makes up the sides and bottom of one bag and furnishes the frame of the other. These plastic frames are available in a number of colors and sizes

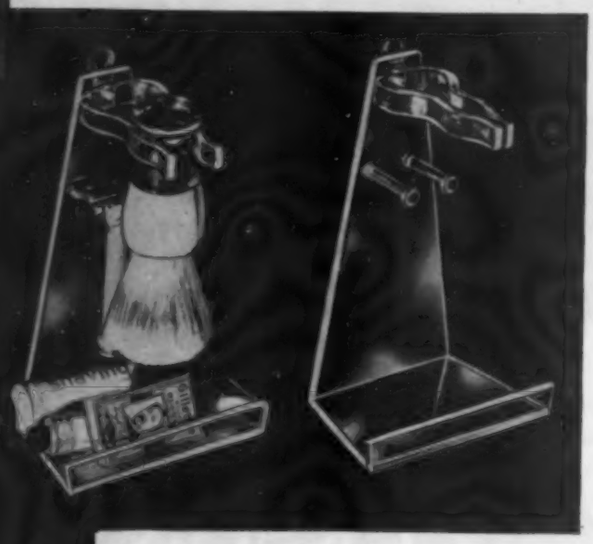
No more scattered tobacco when she carries a grooved 2-color Tenite case; American Molding Co. molds for Continental Merchandising Co.



PERSONAL ACCESSORIES

It's fun stepping out in Nifty-Kicks. Soles and heels, supplied in 4 colors, are molded of polystyrene by Service Plastics, Inc. Bern Industries, distributor, assembles molded parts and attaches leather outer sole and vinyl straps, extruded by Anesite Corp. and Perfex Plastics, Inc.

A shaving accessory with a special place for everything—a razor, a brush, some blades and cream. An interesting feature of this Plexiglas or Lucite stand, which is made by Creative Plastics, is the 2 metal screw rods which extend to back or front at will



Traveler's aid to the gentlemen is this dressing set molded of cellulose nitrate by Joseph Davis Plastic Co. for Philip Florin, Inc. The toilet articles are long wearing and resist cracking and chipping

The addresses of the companies mentioned on these Plastics Products pages are listed on page 220 to facilitate inquiries

Delicate shaded novelties to harmonize with your every whim. With all the depth and lustrous sheen of the opal, these accessories are hand-carved and polished from pearlized Lucite by the Ortho Plastic Novelties, Inc. The frames on back are of acetate

Attractive desk fittings such as this pen stand, cigarette package holder and box can be fabricated from a reprocessed scrap acrylic that has been dyed a mottled color. Material can also be formed

A new mottled acrylic sheeting

FABRICATORS have a new material in a mottled sheeting called Mottletone[1] which is made from reprocessed acrylic scrap. Available in many color combinations, it is presently being made up into such articles as are pictured on this page. But it can be formed as well as fabricated.

In producing this sheeting, acrylic scrap is first cleaned in a tumbling apparatus. From there the material goes to an air oven where it remains until it reaches a temperature of approximately 350° F., moving then to a mixing mill where the acrylic is ground. The mixture is peeled off the rolls of the mixing mill and placed in hydraulic presses where, under adequate temperature and pressure, it flows into semi-positive molds and is cooled. During these processes dye and plasticizer have been added. At present the plastic is made up in sheets which are 20 by 20 or 25 by 25 in. in various thicknesses.

Because of its mottled coloring this material shows surface scratches much less than does clear material, although actually it is no harder than other acrylics. Tests have indicated that Mottletone has a strength of 5000 to 8000 p.s.i. at a temperature of 80° F. and 50 percent Rh. It has a satisfactory resistance to a 40 percent solution of acetic acid, to battery acid, to gasoline (if it is not ethyl), to hydrochloric acid, hydrogen peroxide, kerosene and oakite.

Its handling and care is much like that of regular sheet acrylic. A jig saw band saw or circular saw can be used to cut this sheeting—best results coming from blades with 6 to 9 teeth per inch. Experience has shown that drum sanders are best for curved edges, disk sanders for straight edges, and belt and vibratory sanders for surfacing. There is no obstacle to the tapping and threading of this sheeting if too much material is not removed at one time and if the plastic is kept at a cool temperature.

A table lamp having a mottled scrap acrylic base illustrates how this material can be formed into simple curves

While this material does not lend itself to compound curvatures, it is easily fashioned into a simple curve. The heating is best accomplished in an air oven. Care should be taken, however, that the temperature does not exceed 225° F.

Typical of what can be done with this material are the ink stand by International Display Co., clock by Elexa Mfg. Corp., lamp by Ruzak Industries, cigarette package holder by Lumier Plastics, all of New York City and cigar box by Kayplex of Paterson, N. J.

[1] Product of Plasti-Chrome, Inc., Paterson, N. J.

PLYWOOD

ALL PHOTOS, COURTESY UNITED STATES PLYWOOD CORP.

Uses of plywood are deftly demonstrated in the 4 offices on these pages. Above—The curved walls are made of Teak wood bonded to a canvas backing, as is the leaf mural on the rear center door. Plaques attached to grill-work at extreme left are of various veneer inlays

Below—Dark painted walls combined with light Oak plywood paneled walls make a striking contrast in this double office. The flexibility of ¼ in. thick stock is illustrated by 4 concave panels above fireplace and bookcase

can give new interior effects

MORE than 1,000,000 lb. of phenolic resin are used monthly for adhesives—nearly all of it going into plywood processing. Even greater quantities of urea resin go into this same industry. Of course, large amounts of casein, soybean starch and animal glues are also used, but it is safe to assume that the tremendous increase in plywood production during the war years and the growth expected in the near future are closely associated with the development of synthetic resin bonded plywood.

A foretaste of what the new types of plywood are and what can be done with them is contained in the four pictures used to illustrate this text. These are rooms in the new Weldwood Building, in New York City, the headquarters of the United States Plywood Corporation. The modern designs, well suited to modern conceptions of office economy and efficiency, are the work of Vernon F. Sears, staff architect of the Corporation.

Not only are the plies of the Weldwood and Weldtex panels bonded with urea-formaldehyde based glues, but in many instances the panels are held to the 2 by 4 in. framing by a urea adhesive. For exterior use (not shown in these illustrations) where the plywood must be weather resistant, a phenolic base glue is used to bond individual plies.

Above—Striated plywood, cut into squares and set diagonally, is used for the right wall of this office. The file cabinet, built flush with wall, conserves space and molded laminated desk top (foreground) is cigarette proof

Below—A penthouse office utilizes innovations made possible with plywood—a lamp base, and ceiling fixture made by bonding veneer to aluminum; Elm faced lampshade; rotary cut picture frames and paneled walls

Light, fine, tail, clip, small, heavy and stiff combs are among types made to suit the taste of the consumer

Problems in promoting proprietary items

Market analysis, sales methods, functional design, economical molding combine to sell small, variously priced items

WHEN a plastics molder decides to market his own branded products, backed by his name, in a competitive field, he is faced with problems little known to custom molders. A typical example of these problems and a case history of how they were overcome is found in the operations of the Modglin Company of Los Angeles, Calif., makers of combs, hairbrushes, toothbrushes, handbrushes, compacts, thimbles and a variety of other small items.

A comb for every taste

This company's comb market, for example, embraces the variety chains, the drugstore field, the small notion shops, hardware and grocery stores, at least 3 departments in a department store, and a similar set-up in mail order houses, beauty parlors, barber shops and even on cigarette stands. Each of these outlets serves a wide variety of customers; and each customer seems to have a very personal idea of the kind of comb he wants, how long he wants it to last and what he is going to pay for it. How wide a variety of products is needed to meet these demands can be seen in the partial presentation of this company's combs in Fig. 1.

Boys, and oftentimes men, want combs that will clip to the inside of their pockets like automatic pencils. Up to a certain age the male comb user likes bright colors; beyond that age he wants black or brown. Little girls and misses of any age want combs that look like mother's; but they want them lighter in weight and brighter in color. Women want a variety of combs for specific uses—tail combs, heavy and stiff combs, light and fine combs, and small combs. The hairdresser and barber usually has several combs—all identical in every respect—of the weight and size that

best serves his or her purpose and type of work.

Professional combs and some combs for home use must be boilable for reasons of sanitation and must, therefore, be molded from heat resistant plastics. To date, nylon has proved to be the most popular plastic for this use with this company. Combs for consumer use must be relatively impact resistant and easily washable in very warm water. Modglin is making this category chiefly from polystyrene and cellulose acetate.

Replacement of combs is not, according to this company, nearly as much a matter of breakage through strain as it is a matter of loss and destruction by thoughtless abuse.

Brushes and various small items

As for its brushes, the company uses nylon bristles exclusively. The brush backs are of cellulose acetate and Lucite, injection molded with oriented material. To remove internal strains, the backs are annealed.

This company's "Un-Die Pins," which are made of cellulose acetate, its large salt and pepper shakers produced of the same material, the tumblers molded from polystyrene and its thimbles—all exclusive designs with merchandiseable features—are sold through some of the same outlets as the combs. Their sales are supported by display cards, window stickers, sanitary packaging and advertising.

The company is now in the export field, with distributors all over the world. Here again the firm has found that styles and colors of combs must be adjusted to the market. In spite of the fact that G.I. Joe went all over the world, regional preferences continue, and they must be considered in all export sales promotion.

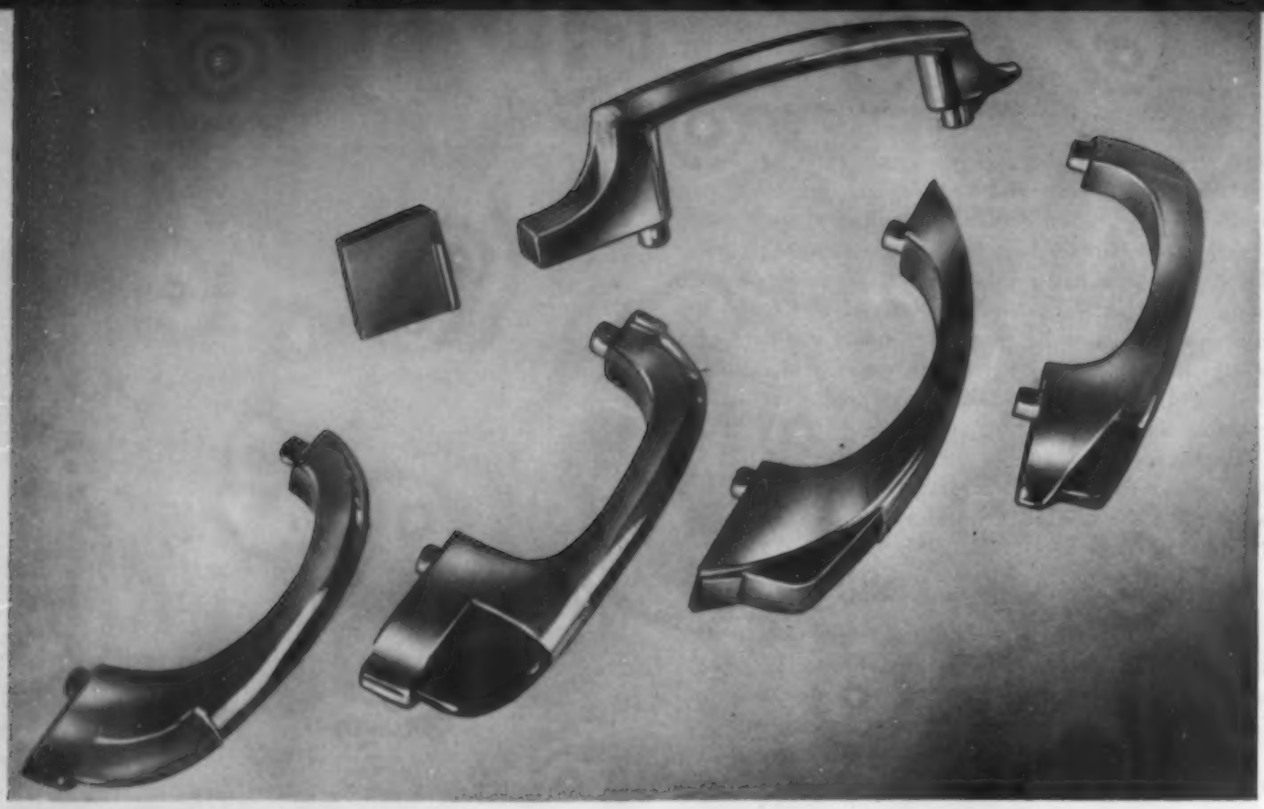
Nylon bristles are used in toothbrush handle of cellulose acetate. Cellulose acetate is also seen in the salt and pepper shakers. Tumblers and thimbles are of polystyrene

COMPACT, LIGHT IN WEIGHT, VIBRATION-free and cool to handle, the new Electri-Craft electric hand-power tool, made by Casco Products Corp., Bridgeport, Conn., is a complete portable power workshop in miniature for both the professional and amateur craftsman.

A problem faced the designers in the housing for the motor. The tool's balance is based on a "pencil grip," which meant that the motor plus the housing had to weigh but little more than the grip plus the tool accessory. The housing also had to be shock-resistant, sweat-proof and abrasion-resistant if it was to meet the need.

A special formulation of cellulose acetate was finally chosen. The housing is molded in two halves, and mechanically braced and held in assembly through a die-cast aluminum frame. Two tops and two bottoms are injection molded at one time at a temperature of about 375° F. The company is at present experimenting with other plastic materials, including ethyl cellulose, with a view to obtaining even better impact resistance in the housing of this tool.

The switch buttons are also molded from cellulose acetate—eight to a sprue. To secure maximum efficiency in injection molding the company uses oven drying and infrared conveyorized drying equipment for powders, and special degrating fixtures. Several other parts of the tool also feature the use of plastic. The brush holder insulation is plunger molded, 40 at a time, from phenolic material. Field coil spool and commutator assembly are also made of phenolic material, while many small parts are fabricated from laminated phenolic tubing and sheet stock.



Kitchen fixtures of chrome with cellulose acetate or polystyrene inserts. Top shows parts before assembly

Marketing pretests indicated plastics

Kitchen fixtures of cellulose acetate and styrene meet the demand for colorful, easy-to-clean hardware

THE great American kitchen, the envy of womankind the world over, suffered as much from lack of refurnishings during the war as any room in the house. Not only were there no appliances; there was a shortage of gadgets and of hardware. Consequently, the present market for kitchen hardware will not only include contract sales to the people who will build the 2½ million homes projected for the nation during the next year—but sales to a great number of women who want to smarten up their present kitchens with bright and colorful new hardware.

The Stanley Works, a company that has been long famed for quality production of wood workers' tools, has entered this market with a beautiful line, the designs of which were pretested by trade and consumer research. Stanley F. Chamberlain and Sundberg-Ferar were the designers chosen for the job and the line represents the best ideas of both design houses.

A canvas of jobbers and retailers to find out what they and their customers did not like about prewar kitchen cupboard hardware and what they wanted in possible postwar lines proved most enlightening as the following four points of opinion will go to illustrate.

1. Neither the retailers nor the housewives wanted dirt catchers.
2. They demanded hardware that is easily cleaned.
3. They wanted thumb control of catches.
4. They wanted color. And their color desires were predominantly for black and brilliant red.

The company is using both cellulose acetate and polystyrene in its line. The acetate parts are molded by Craven & Whittaker Co., Providence, R. I., the polystyrene fixtures by the General Electric Co. Pittsfield, Mass. In addition to the red and black plastic components, clear polystyrene will be available where the style makes it advisable.

The decision to use plastic and the choice of colors is an interesting example of modern product design technique. The most sterile color combination in the world is white and chrome; yet many people hesitate to slap colored enamel around a kitchen. Chrome is actually a bluish color. So the red plastic selected for this job has a bluish rather than a yellow cast. Market acceptance is reported to be terrific.

Vinyl acts to preserve anatomical structures

BEGINNING students of anatomy, bent over a small laboratory animal, often cut too quickly or overlook entirely the parts which they are dissecting for study. As an aid, skeletal replicas with circulatory systems of colored Vinylite have been produced by Ward's Natural Science Establishment, making this company the leading supplier of such materials to scientists, medical schools, colleges, educators and special collections. These aids are known as plastic corrosion preparations.

The process by which the veins, arteries and other anatomical structures are injected with vinyl resin is surprisingly simple—so simple, in fact, that students can prepare the animals themselves. It involves only the forcing of colored plastic into the arteries and veins with a syringe of the type used by veterinarians—red for the arteries, blue for the systemic veins and yellow for the outlining of important organic differences. A 10 cc. syringe, preferably one with a rubber plunger, is considered as the best size to use. The size of the canula or needle varies with the size of the blood vessels to be injected. An 18 gage size is used most often.

After injection the Vinylite hardens very quickly and no special treatment is required for setting. The animal tissue may be allowed to rot away naturally or may be removed by bacterial maceration at 90° F. When the tissue is completely softened it can be washed away under a jet of water.

Once the cast of the circulatory system is free of soft tissue and dried, it may be mounted in a glass-topped case or a double view mount, or it may be attached to a glass plate and mounted in a glass jar containing 5 percent formaldehyde. It is not absolutely necessary to mount the cast since it possesses enough strength and rigidity so as not to be easily broken.

The company supplies both ready-made models and the colored vinyl resin with which anatomy students can prepare their own specimens. Among the corrosions available are those of frogs, cats, rats, dogfish, turtles, pigeons, pig embryos and sheep kidneys.

PHOTOS, COURTESY WARD'S NATURAL SCIENCE ESTABLISHMENT

The liver of a cat and the circulatory system surrounding it have been injected with colored vinyl solutions to simplify the study of the specimen

The blood circulatory system of a cat after surrounding tissues have been removed. Colored vinyl solutions are red for arteries, blue for veins and yellow for outlining other organisms

These specimens may be sealed in a jar or mounted in a case

PHOTOS, COURTESY HARDWOOD LINE CO.

Left—A methyl methacrylate barrel is supported above vat by a hoist. During plating process, barrel is lowered into solution and revolved constantly. Right—Methyl methacrylate cylinder being perforated on a radial drill following forming operation. Metal templates insure accurate spacing of the holes

Acrylics make good plating barrels

THE life of a plating barrel is not a pleasant one. These units, customarily made of hard rubber or laminated phenolic material, must be able to withstand exposure to various acid and caustic solutions employed in the plating process. Loaded with metal or plastic parts to be electroplated, the barrels are submerged directly in the plating solution where by slow rotation they cause the parts to tumble constantly and insure an even deposit of the plating.

Hardwood Line Co., Chicago, Ill., experimented some time ago with individual Lucite plating barrel panels and obtained encouraging results. The company is now fabricating entire plating barrel units of this material, producing a seamless hexagonal barrel which loads and unloads easily, has no inner framework to interfere with the tumbling action and possesses other desirable properties.

Portable as well as larger models of the plating barrel are manufactured by this firm, all employing the same basic construction. On the larger sizes, the hexagonal plastic barrels measure 14 in. in diameter and 30 or 36 in. in length. These may be used in either single or multiple barrel installations.

In use, the barrels are loaded approximately one-third full with nuts, bolts or miscellaneous screw machine parts and lowered into the solution. The standard sized barrels rotate about 6 r.p.m. during the plating process, which requires approximately 20 min. for a typical plating job. The temperature of the plating solution averages from 90 to 110° F. However, the temperature should not exceed that of 140° F. with the methyl methacrylate barrel.

The fact that the smooth inner surface of the barrel permits unobstructed tumbling of the parts being plated has an important bearing on plating results and economy of operation. If small parts stick in a plating barrel, they tend to accumulate excessive plating and in time ionize the barrel, causing lumps of plating to *tree up* on its inner surface and reducing its operating efficiency. Extremely durable, the methyl methacrylate

barrel has the further properties of inertness to both caustic and acid plating solutions and low electrical conductivity.

Fabricating the sheet acrylic

The barrels and several other component parts are fabricated from sheet methyl methacrylate ranging in thickness from 1/4 to 1/2 inch. The small portable unit, having a net weight of 20 lb., typifies the method of fabrication employed for all sizes. The barrel of this model is fabricated of 1/2 in. sheet. The material is cut to size, then clamped around a hexagonal steel cylinder to give it the proper shape. The necessary heat for this forming operation is provided by an oil bath carried at a temperature of approximately 300° F. After forming, the cylinder is removed from the bath, cooled on the form and slid off the end. Edges are then milled to provide a proper fit for the loading and unloading door. The latter, fabricated of a single sheet of the methyl methacrylate, is held in place on the barrel by neoprene-insulated spring steel clamps.

The hexagonal end plates of the cylinder, also of methyl methacrylate, are cemented in place with ethylene dichloride. The large methyl methacrylate ring gear, cut on a gear hobbing machine, is fastened to one end of the cylinder by means of steel screws which are countersunk and capped with methyl methacrylate plugs. On the small model, this gear is fabricated from 1/4 in. stock. Also of methyl methacrylate are the small pinion gear which drives the ring gear and the hood which protects the motor.

All six faces of the plating barrels are pierced by hundreds of holes which permit the plating solution to enter the barrel when it is immersed in the vat. These perforations are individually drilled on a drill press, a metal jig being employed to obtain the proper spacing. Holes are of 1/16 in. diameter on the portable model and somewhat larger on the larger barrels.

Bearings on the tumbling barrels are also of methyl methacrylate. The barrel ends have a collar bonded to them, carrying a methyl methacrylate insert in which the unit revolves. The bearings are drilled to permit the entrance of the cathode danglers, which are of steel insulated with synthetic rubber. As the barrel revolves, the dangler tips remain in position at the bottom of the unit. The plating solution itself provides the necessary lubrication for the bearings.

In the single and multiple installations of the larger sized cylinders, motors may be mounted on an overhead frame or on the side of the plating tank. On the small units, the motor is supported by a methyl methacrylate motor base.

A SET OF MODERNFOLD DOORS, MADE from a vinyl coated fabric, is a handy item to have around the house—or most any edifice, for that matter. The housewife who wants to separate the kitchen from the dinette, for example, can do so by having the doors installed at the location where she would like to have the wall. The man who wants his office to be divided for additional privacy or the shopkeeper who desires to hide certain unsightly stocks behind closed doors can both make ready use of the doors. In fact, the uses for the doors are innumerable and their mobility gives them advantages over the installing of a permanent wall.

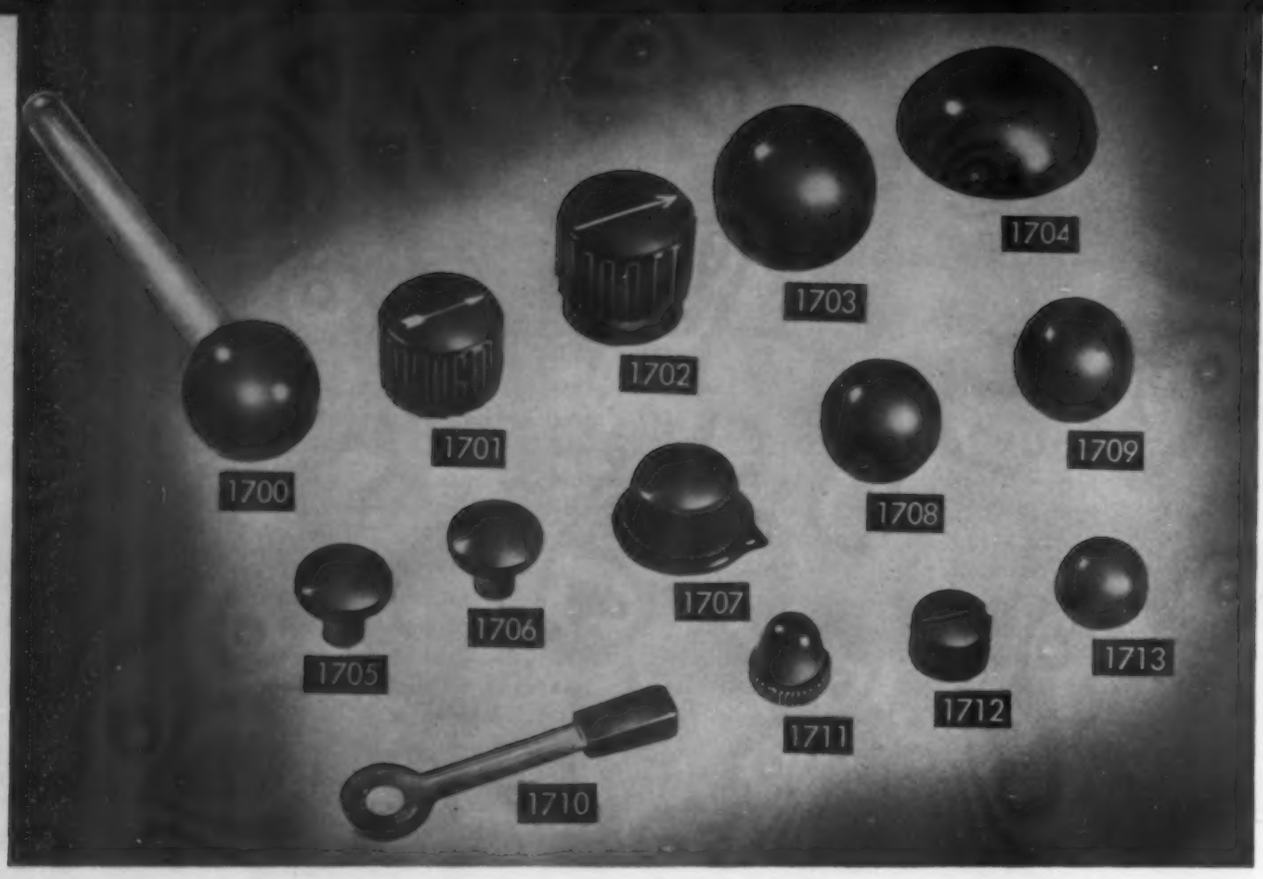
PHOTO, COURTESY NEW CASTLE PRODUCTS

In the first place, the Modernfold doors are easy and relatively inexpensive to install; secondly, they economize on the space required by swing-type doors; thirdly, they are supplied in 28 hues to match or harmonize with any color and their unobtrusive design fits in with most decors. Another interesting characteristic of the doors is that they may be installed so as to form a curved closure.

A metal framework is used to support the vinyl-coated fabric[1] whose flexibility renders it very suitable for the doors which are folded in accordian-like fashion to consume as little space as possible. The material is mildew-proof, can be cleaned with a damp cloth and makes possible the variety of colors in which the doors are supplied. One of its most important qualities is its resistance to flame and fire. This factor has opened up many potential fields where the use of flammable materials would be prohibited.

Modernfold doors, which are manufactured and supplied by New Castle Products, New Castle, Ind., slide along an inconspicuous track attached to the ceiling. Handles are of Lucite.

[1] Material supplied by E. I. du Pont de Nemours & Co., Inc., Newburg, N. Y.; U. S. Rubber Co., Mishawaka, N. Y.; Columbus Coated Fabrics Co., Columbus, Ohio; Textileather Corp., Toledo, Ohio.



Plastics Stock Molds*

SHEET ONE HUNDRED FORTY-FOUR

Knobs of all sizes and shapes with special inserts can be used for all types of electrical, radio, automotive and other products. Manufacturers' names and addresses may be obtained from the Stock Mold Div., Modern Plastics, 122 E. 42nd St., New York 17, N. Y. Please state sheet and item number.

1700. Ball handle, overall diameter 1 1/8 in. Can be molded directly on 3/8 in. diameter rod up to 3 3/4 in. long.

1701. Serrated knob 1 in. in diameter. 23/32 in. high with 25/32 in. counterbore. 3/16 in. deep. Inserts to fit stand shaft may be tapped and drilled for set-screw. Available with or without indicating arrow.

1702. Serrated knob, 1 1/8 in. in diameter. 1 in. high. Available with inserts to fit standard shafts. May be drilled and tapped for set-screw.

1703. Ball handle, 1 3/8 in. in diameter. Available 3/8–18, 7/16–20 or 1/2–20 metal inserts. Special threads available where quantities justify.

1704. Mushroom-type knob. 1 3/4 in. diameter. Available with 9/16–18 or 1/4–20 brass inserts.

1705. Tapered knob, 3/4 in. in diameter with 1/4 in. shank. 21/32 in. high. 6/32 or 8/32 brass inerts.

1706. Same as above, with 10/32 inserts.

1707. Pointer knob for electrical or radio controls. Available 1 1/8 in. in diameter with 1/4 in. plain brass insert and setscrew.

1708. Ball handle, 1 in. in diameter, with 3/16–18, 5/16–24, 1/4–20, 1/4–28 threads; 8–32 or 10–32 threads.

1709. Same as above, with 5/16–24 molded threads.

1710. Lever-type handle approximately 7/32 in. high by 11/32 in. wide by 3/4 in. long, to be molded directly on metal levers 1/32 in. by 1/4 in. up to 2 1/2 in. long.

1711. Thumb screw, approximately 49/64 in. high, 5/8 in. in diameter. Can be molded with 5/40, 6/32, 8/32 or 10/32 inserts or studs.

1712. Adjusting knob, 5/8 in. in diameter, 11/32 in. high. Available with 1/4 in. plain or threaded hole. Can be drilled and tapped for set-screw. 1/16 by 1/16 slot across face.

1713. Small, round control ball, 3/4 in. in diameter with 10/32 in. tapped thread.

Items 1–1582, which have appeared previously, are correlated in the Plastics Stock Mold Catalog ($5.00).

Molders and fabricators are invited to submit samples of stock products to appear on these pages as space permits.

* Reg. U. S. Patent Office.

Plastics Engineering*

F. B. STANLEY, Engineering Editor

Techniques of extruding acrylic

by JAMES BAILEY†

THE extrusion of acrylic resins is very similar to the extrusion of other thermoplastics except in two major respects:

1. Acrylics, at temperatures necessary to give a good surface and structure, are prone to suffer from bubbles as a result of breakdown of plastic into gas monomer.

2. Acrylics are premium materials that must meet much higher standards of clarity, color and dimensional tolerance to justify their use. Moreover, in extruded form they are in direct competition with the beautifully clear cast material, a circumstance which limits the price of the extruded product in those forms and sizes that can be as readily produced by the casting method.

There is, however, a field for extruded shapes which can form the basis for a lucrative business. But, just as with other thermoplastics, success in this field depends first of all upon obtaining a molding powder into which the manufacturer has incorporated the necessary quality. This is perhaps truer of methacrylates than of other materials because acrylic products must be haze free, as well as low in color and possessed of a lustrous surface.

Fortunately, the materials manufacturers have done an excellent job and it is only once in a while that badly off color or dirty powder is received. There are, however, decided differences between lots of the same material and between various kinds of acrylics. Some will extrude with a glossier surface than others, some will be yellowish-green, still others will have a yellowish-amber cast. In long pieces, there is always a tendency toward dullness as compared to cast rod.

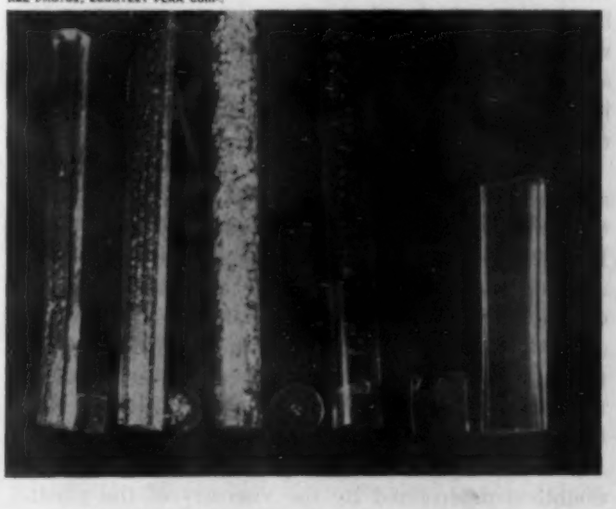
Bubble trouble

The first stumbling block experienced by the extruder is bubble trouble. There are two kinds of bubbles encountered in extruded plastics: 1) general bubbling and 2) vacuum bubbles.

1. *General bubbling* occurs in the form of small fine bubbles due to the liberation of gas during the time the plastic is soft throughout. Such bubbles are shown in Fig. 1 in the first, second and fifth pieces; reading from left to right. The first and second pieces are polystyrene, the fifth is methyl methacrylate. They were made by direct extrusion and the bubbles developed slowly during cooling, being generally distributed throughout the sections as shown. The third and fourth pieces were made from methyl methacrylate by the Lubofilm system and the bubbles are the result of extruding through the die into the air at such a high speed that the center of the rod is still hot. These bubbles are due to the vacuum created when the center tries to shrink as it cools and is, therefore, thrown into hydrostatic tension since the outer layers are already cool and cannot shrink correspondingly. Viewed through the side of the round rod, the bubbles appear to be generally distributed, but the end sections show that the bubbles are confined to a small section at the center.

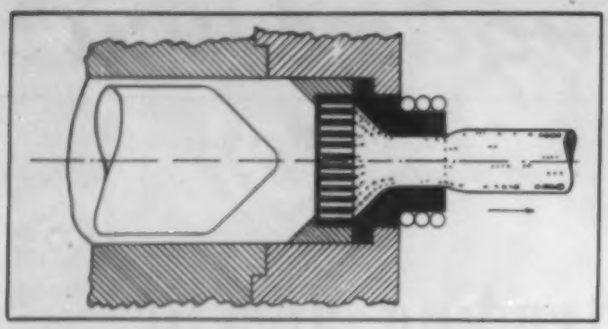
Drying of the molding powder, the common way of eliminating this difficulty, has met with little success. Attempts to eliminate the bubbles by dropping the

ALL PHOTOS, COURTESY PLAX CORP.



1—*Bubbles in 1st, 2nd and 5th pieces, made by direct extrusion, develop slowly during cooling. In 3rd and 4th pieces bubbles result from extruding at high speed*

* Registered, U. S. Patent Office.
† Plax Corporation, Hartford, Conn.



2—Low pressure and regions of slow plastic motion, due to use of short die and arrangement of breaker plate and screens, causes the formation of chain bubbles

3—Extruded piece showing bubbles caused by Fig. 2 set-up

temperature have been found to cause so much back pressure that most machines will not pull the load. A breaker plate and screens used in conjunction with a short die and set close to the end of the screw are quite likely to result in chain bubbles such as are shown in Figs. 2 and 3. These bubbles apparently form at the ends of the grid between the holes in the breaker plate where the pressure is low because of the short die and where there are regions between the holes in the breaker plate where the movement of the plastic is slow. Streamlining of the breaker plate helps but does not entirely eliminate the trouble. A long die which gives a higher back pressure on the breaker plate will do away with the bubbles at the die, but they may reappear at some distance from the die though in this case they will be more generally distributed throughout the extrusion and will show less of the chain effect.

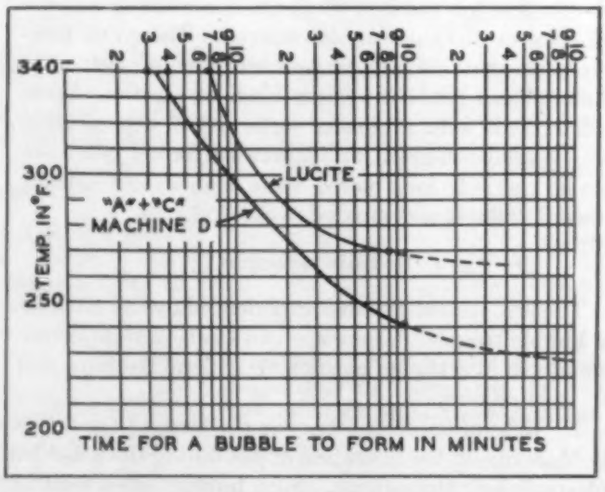
If the plastic coming from the die is carefully observed, it can be seen that the bubbles usually form in the extruded plastics a certain distance beyond the die. Except in very thin sections, cooling of the plastic will not stop or delay the formation of these bubbles. The distance from the die at which the bubbles form may be converted into time if account is taken of the speed of the extrusion. It may be said, therefore, that a certain time is required for the bubbles to form—longer for a low temperature stiff plastic than for a hotter plastic.

While the speed with which the bubbles are formed is doubtless determined by the viscosity of the plastic, there are other factors involved. The gas is dissolved in the plastic at high pressure and is in a state similar to that of dissolved crystals in an undercooled liquid. Some break in the structure must be present before the gas phase can separate out in the form of bubbles. Any little speck of foreign matter will supply this break, hence dirt in the powder, from whatever cause, will start bubbles. Moreover, just as the stirring of an undercooled liquid will cause instant crystal formation, under low pressure conditions, friction along the surfaces of the breaker plate will cause the instant formation of bubbles on the back of the breaker plate as in Fig. 2. So it is that the machine set-up as well as the powder are factors in the formation of bubbles.

Some years ago, our laboratories investigated the time-temperature characteristics of *bubbling* in several kinds of acrylic. A rod of bubble-free extruded material was placed in a controlled temperature bath and held at various temperatures. Both the bath and the container were transparent so that the specimen could be observed. The results are shown in Fig. 4. It will be noted that several minutes are required for bubbles to form at the lowest practicable extrusion temperatures if the material is quiescent.

A similar set of observations but under superimposed pressures indicated that a constant pressure on the hot plastic of as low as 20 p.s.i. would prevent bubbles from forming. While it would seem easy to extrude into a back pressure chamber, actual experience indicates otherwise. Figure 7 shows such a chamber. The chamber may be filled with liquid or gas, and the right hand end may be attached directly to the die.

The plastic being soft, the pressure P sets up a hydrostatic pressure in all directions within the plastic as shown by the little cube of material in Fig. 7. At each end of the chamber, the plastic passes through a stuffing box or its equivalent into a region of atmospheric pressure. The force F acting on the rod would be $\pi R^2 P$, where πR^2 is the area of the rod. If the right end of the back pressure chamber is connected to the die, the plastic will be forced into the extruder, but the friction of the stuffing box (2) and hold-back (3) must exactly equal F or the rod will either stretch and be



4—Time-temperature characteristics of bubbling in methyl methacrylate

blown out or will refuse to move and pile up inside the chamber. The back pressure chamber has been superseded by the Plax Lubofilm method (described later).

Methods of extrusion

There are three divisions of extrusion: the direct or coordinated method, the semi-positive method and the positive method.

1. *Direct method*—In the direct method, it is necessary to design a die to give the proper shape; to coordinate the speed of the extrusion with the speed of the take-off device, to control the cooling (to prevent warping) and to provide innumerable gadgets to prevent the extrusion from sagging out of shape. Bubble trouble must not be overlooked.

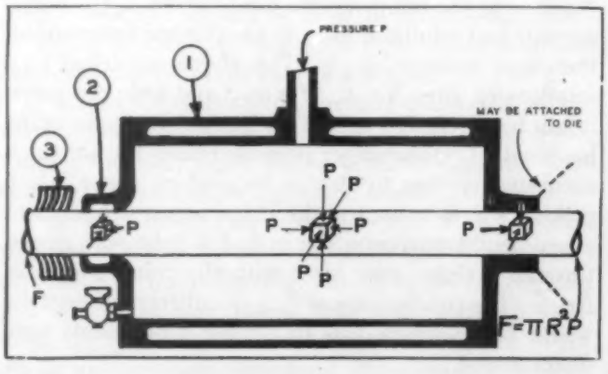
2. *Semi-positive method*—The semi-positive method is one in which the most important surface, or surfaces, is controlled by a mold. Typical examples are the blowing process, where the outer surface is controlled by a mold, and the tube sizer method of extruding tubing. In both cases, variations affect only the wall thickness.

3. *Positive method*—The positive method is one where all surfaces are controlled by some sort of mold and the part produced is always an exact replica of the mold. Variations may result in some rejects, but it is not necessary to coordinate a varied assortment of apparatus to produce a good part. Typical examples are injection molding, transfer molding and extrusion molding.

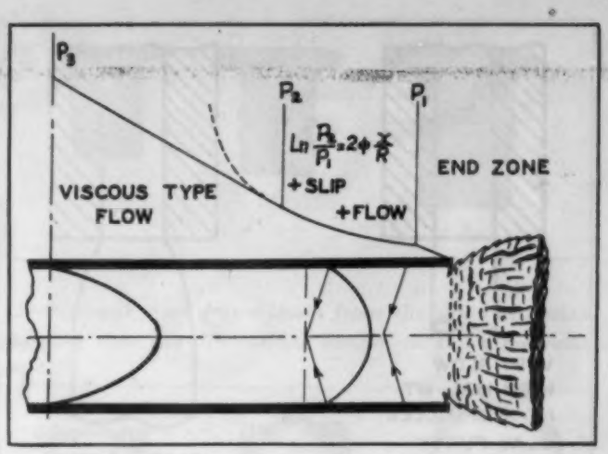
Direct extrusion

It is admitted that plastics are rheological materials and that they do not follow the simple laws of viscous flow. Nevertheless, the departure from truly viscous flow is not so great but that some interesting conclusions can be drawn from assumptions based on viscous flow. These lead to the conclusion that the flow through a simple smooth tube or die is something like that shown in Fig. 5.

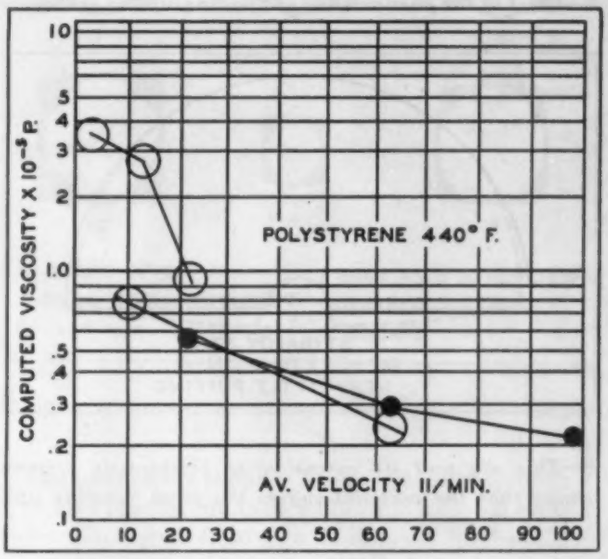
In this illustration the flow takes place from left to



7—Auxiliary pressure chamber to inhibit bubbles. Component parts: 1) jacketed pressure chamber, 2) stuffing box, 3) adjustable hold-back. Friction of parts 3 and 2 must balance F or the plastic will either neck down or bunch up



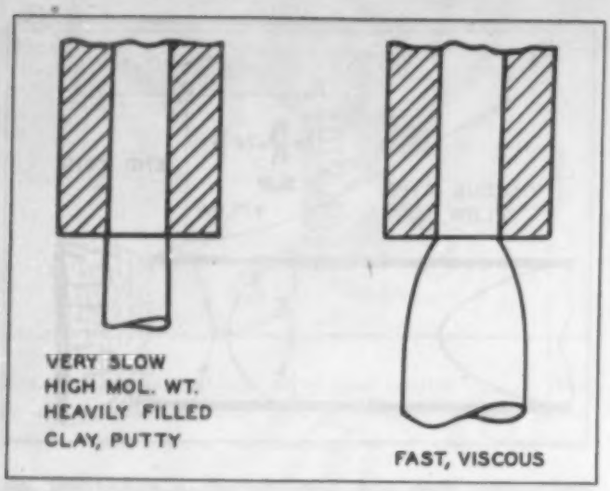
5—Pressure drop and flow through a cylindrical die



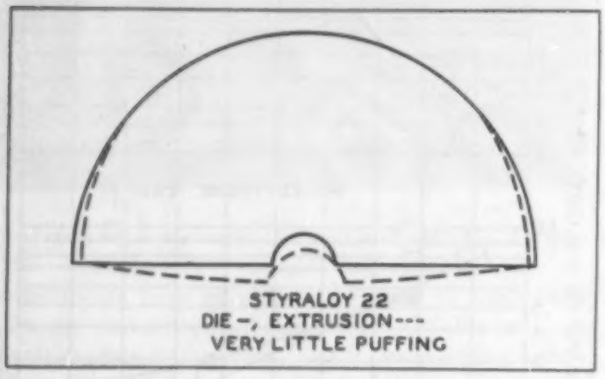
6—Typical change of apparent viscosity in plastics as a function of velocity

right. At and near the left hand end, the hydrostatic pressure P_3 is so great that the plastic is locked against the wall and cannot slip. Movement must take place by shear within the material. Thus, at a certain instant, a line of molecules along the line of P_3 would move to the right, assuming sometime later the parabolic shape indicated in Fig. 5. Nearer the exit of the die, at P_2, the friction against the die is reduced to such an extent that some slippage occurs which reduces the severity of the parabolic flow. Very near the die at P_1 an anomalous region of instability exists with the result that heavily filled materials are likely to develop a pattern of cracks.

These cracks tend to take place even in such plastics as polystyrene and cellulose acetate and to a lesser extent in the methacrylates. In most plastics they cause a fine matte surface which is very evident in polystyrene when extruded at a low temperature and which appears as a smoky dulling of the surface in methacrylates when extruded at a very low temperature. This dulling re-



8—*Effect of the phenomenon of "puffing-up" in extrusion*



9—*This die and its extrusion of elastomeric styrene shows that the material suffers less from "puffing up"*

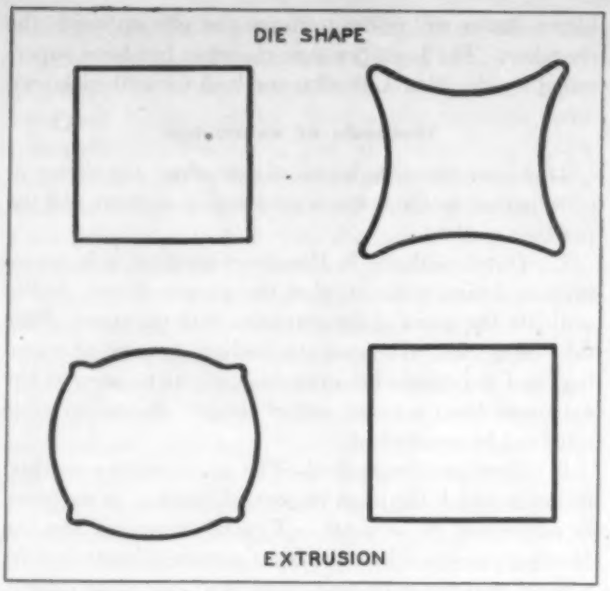
mains on the surface if the plastic is cooled rapidly near the die. The surface will come clear, however, a short distance after the material leaves the die if the surface is allowed to stay hot.

The effect of high rates of extrusion is to cause an apparent drop in the viscosity of the plastic, as shown for polystyrene in Fig. 6.

The combined results of the flow shown in Fig. 5 and the viscosity change shown in Fig. 6 is to make the material *puff up* (Fig. 8). Both polystyrene and the extrusion grades of methacrylate show this effect very decidedly, whereas such materials as highly filled plastics and Styraloy (Fig. 9) show it to less extent.

The phenomenon of puffing up is very troublesome when dies are designed for heavy-section complicated shapes. Figure 10 shows a square die (upper left) and the extrusion that it gives (lower left). The die must be made in a shape antithetic to the puffing up (upper right) to give the desired square extrusion (lower right).

To produce a T-shaped piece such as is shown in Fig. 12, a die was constructed $^3/_4$ in. long in the shape shown by the solid lines in Fig. 11. The resulting extrusion had the shape of the dotted lines in Fig. 11 and was hardly recognizable. It required a great deal of



10—*Square die and shape that it extrudes (left) and a corrected die to produce a square rod (which is shown at right top and bottom)*

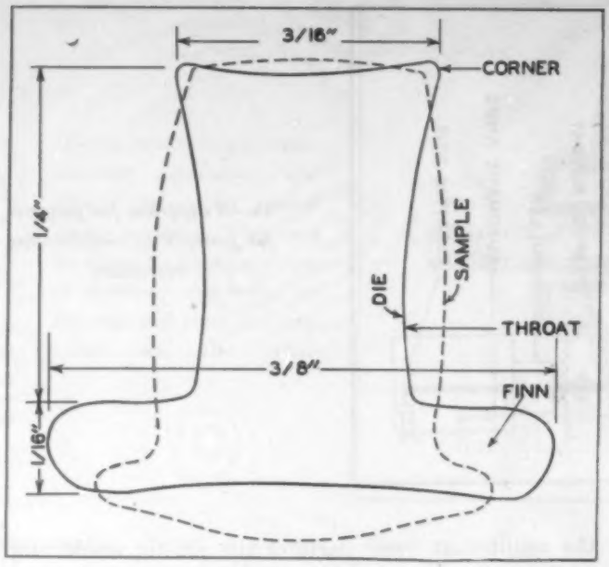
doctoring to produce the desired T shape (Fig. 12).

Once the extrusion has left the die it may be stretched down to almost any size without altering its shape. This is illustrated in Fig. 12 where the finished piece was made $^5/_{16}$ in. high and $^3/_8$ in. across the widest part. The sections shown are considerably magnified but all dimensions remain in the same ratio.

The phenomenon of puffing up prevented the extrusion of shape No. 1 in Fig. 13, a tube with four decorated regions. The tube wall and the decoration act as an enlargement to the flow passage so that the plastic extrudes in a thicker section in this region and generally in a more cylindrical shape than is desired. The material also has a tendency to extrude straight out from the die at these points, and the lateral expansion of the plastic crowds the tube wall outward so that about the best shape that could be obtained is shown in shape No. 2. At the temperatures used for No. 2, the methacrylate had a dull surface. At a hotter and faster speed, the shape became No. 3. This shape, stretched to a smaller size, gave No. 4. If Nos. 3 and 4 are compared it will be noted that except for size no change in shape has resulted. Internal air pressure causes the hot thick decorated portion to stretch to produce shape No. 5 making a sizer to control the shape impracticable. For experimental purposes, the extruded tube was passed through a rectangular sizer with the result shown in No. 6. The conclusion was that an entirely different die would be necessary and all further experiments were discontinued.

Positive methods of extrusion

Extrusion molding—In this method, a mold is used to give the desired shape. It is useful primarily in the production of very large pieces. Either complicated or



11—*To make T shape shown in Fig. 12, the die (solid line) was constructed but it produced shape indicated by dotted lines and had to be doctored to give T shape*

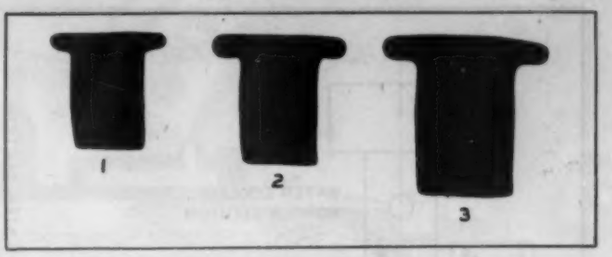
simple shapes can be made in this way. If the piece is large, it is usually necessary to heat-cycle the mold to eliminate flow lines. For a large piece, that weighs approximately 27 lb., 20 to 30 min. are needed to fill the mold and a back pressure of inert gas at a medium pressure is required to prevent excessive bubbling. The mold when full must be cooled from the end farthest away from the sprue, the gate being kept hot so that the shrinkage can be taken up by fresh hot material. It is difficult, however, as is shown in Fig. 15, to prevent a few vacuum bubbles from forming near the sprue.

Unless the mold is well polished and lubricated it will stick to the plastic, making unloading very difficult. But it is possible in the case of a plain cylindrical mold to remove the end of the mold and, by means of the extruder pressure, to push the cooled piece partly out of the mold in successive steps so that a piece much longer than the die can be molded. Eventually, however, it is necessary to empty the mold, clean it and relubricate in order to continue production.

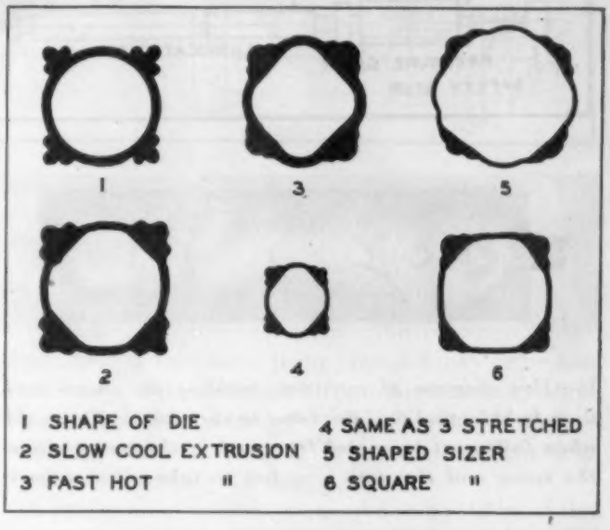
Owing to the necessity of carefully controlling all the factors, this operation requires expert supervision. During the war, pieces up to 6 in. in diameter were supplied in large quantity, made mostly of styrene.

Process of continuous extrusion—The Plax Lubofilm process[1] is a positive method which has been working satisfactorily for years (Fig. 14). The die is very long and is held at any desired temperature by an automatically controlled heater. Plastic is supplied to the die by an extruder, a crosshead and a nozzle. A lubricant which is incompatible with the particular plastic being extruded is forced into the die around the space between the nozzle and the die wall so that the plastic is at all times sliding on a film of lubricant.

[1] A full description of the process is given in Patent No. 2,365,374.



12—*Different sizes drawn down from the same extrusion showing that the dimensions remain in the same ratio*

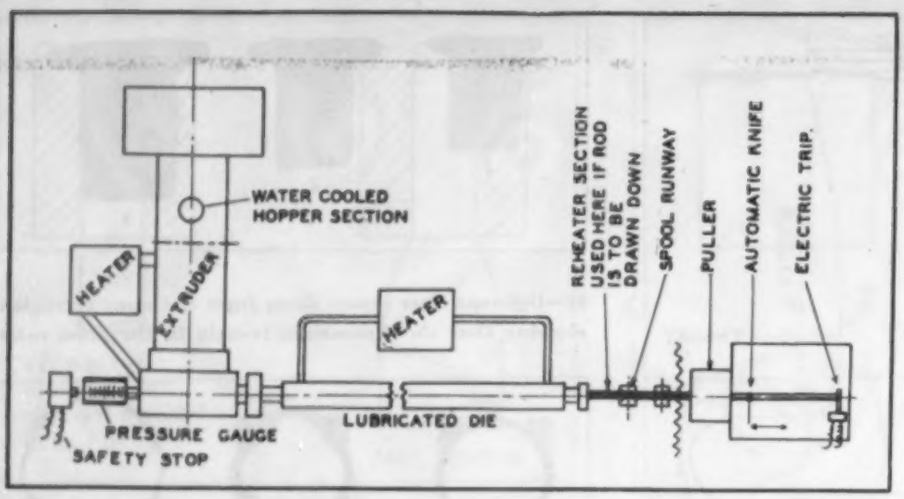


13—*The products of a complicated die for tubing*

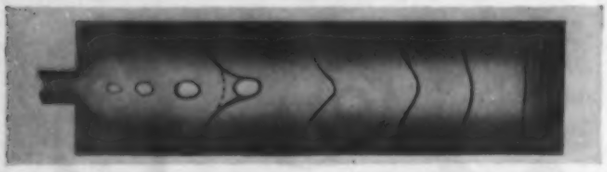
The lubricant is supplied at high pressure through a system of piping containing a filter and a special control valve which gives from 7 to 20 drops of lubricant per minute. The lubricant permits the plastic to slide through the die toward the outgoing end which is provided with a stuffing box and a relief vent. The pressure, therefore, drops continuously from that of the extrusion at the nozzle, which may be 1000 p.s.i. or more, to very little at the stuffing box. The friction of the stuffing box also supplies back pressure which is necessary on large diameter extrusions. Because the film of lubricant is only a few thousandths of an inch thick and must balance the pressure on the plastic at any point, the plastic is formed to the exact shape of the die and cannot either pile up in the die or neck down to give undersize rod.

The output of the die is limited by the time required to chill the center of the rod to a point where vacuum bubbles will not form after the plastic leaves the die. No bubbling can take place in the die because of the high back pressure while the plastic is within it. The dies are very expensive and thus far only simple shapes have been made.

Figure 16 shows a section of a hand rail extruded by the Lubofilm method. The piece was wide and decorated along both sides. Shrinkage made it easy for the lubricant to leak by the plastic at certain places with

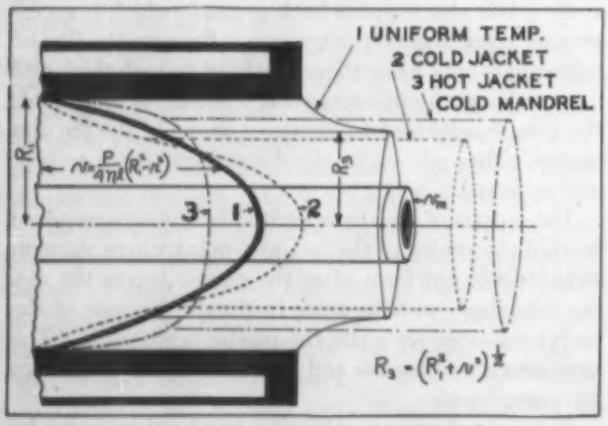


14—A diagram for patented process of continuous extrusion



15—This diagram of extrusion molding die shows vacuum bubbles and flow lines due to shrinkage. The mold when full must be cooled from end farthest away from the sprue and the gate kept hot to take up shrinkage

16—This section of a hand rail wase xtruded by patented process of continuous extrusion. The flow lines apparent in this picture are due to faulty lubrication of die



17—This diagram shows mechanics of flow in system of extrusion shown in Fig. 18. Experience has shown that usually a medium low temperature in jacket is desirable

the result that some parts of the plastic would stop while the stream of hot plastic passed by. Such a behavior results in surface lines which were photographed in Fig. 16 by reflected light.

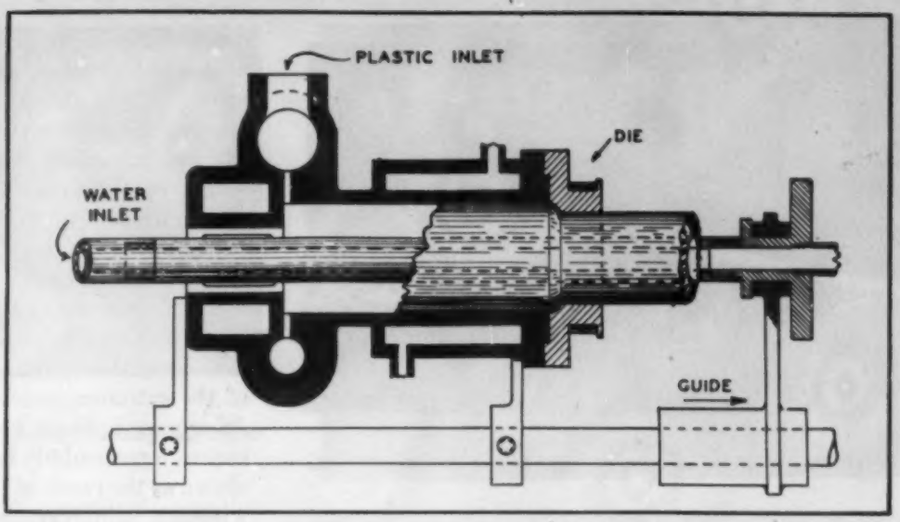
Cooled mandrel die for tubing—To make a heavy bubble-free extrusion it is necessary that the plastic shall be cooled under pressure. This can be done by the system shown in Fig. 18. A series of hollow mandrels are so constructed that each one of them can be screwed into the other. These mandrels are then passed through a jacketed chamber of medium length which is completely filled with plastic from an extruder. The mandrels are kept cool by a stream of water, causing a frozen film of plastic to form on the mandrel. The thickness of this frozen layer increases with time until it has reached the desired thickness. At this point, a die scrapes off the excess plastic which remains in the chamber and the frozen tube and mandrel issue from the die opening. The mandrel is guided at both ends to ensure its being held reasonably true to center—to the left in Fig. 18 by bushings in chamber, to right by sliding guide arrangement. Mandrels are later stripped.

Either simple or complicated shapes can be extruded in this manner. The system works well with any plastic which is heat stable. It is somewhat slow but several units can be attended by one group of men who also strip the mandrels.

The extrusion speed is adjusted by a valve on the plastic coming from the extruder and the mandrel is automatically carried along by the plastic. The exact speed is not critical since the die is heated and can shave off quite a considerable amount of excess of the frozen material.

The mechanics of the flow in this type die are shown in Fig. 17. If no die is used, the extrusion will have a diameter which depends on the temperature of the plastic chamber jacket. Generally speaking, a medium low temperature is desirable in the jacket, and the die size should not exceed that indicated for the particular jacket temperature.

The slipper die—Another positive method, developed by the Plax Corporation, and useful for slab stock or



18—To make heavy bubble-free extrusion, the plastic must be cooled under pressure. This can be done by using a series of hollow mandrels so constructed that one can screw into the other

rectangular shapes is shown in diagram in Fig. 19. Plastic from an extruder is led between reciprocating polished plates whose stroke is somewhat more than half the width of the plastic slab being made. Two stationary guides (5 in Fig. 19) prevent the plastic from expanding sideways. The plates are flooded with a lubricant which keeps them covered with a thin film at all times.

The plates are forced to move by a motor which gives the motion *AB* as shown in Fig. 19. Any slight tendency for the plastic to move along *BC* results in a relative movement *AC* against the slipper plates. Thus, the plastic can move with very little friction through the die. The resisting force of the die is, in fact, so small that a back pressure device on the extruded plastic is necessary to insure complete filling of the space. The slipper die is capable of extruding pieces held very accurately to size but it is slow in pounds per hour since it is necessary to chill the plastic all the way through before it passes into the air. This method produces continuous lengths, however, and requires a minimum of supervision once it is started and has been properly adjusted.

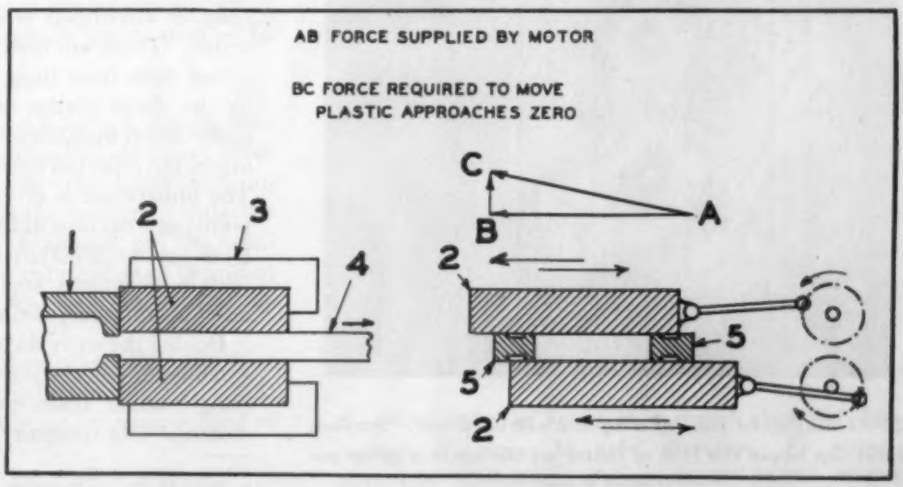
A picture of the first experimental slipper die is shown in Fig. 20. The lubricating mechanism, cranks, drive and plates are clearly shown in this illustration. The extruder is in back and the extruded strip extends outward to the left.

Defects in extrusions

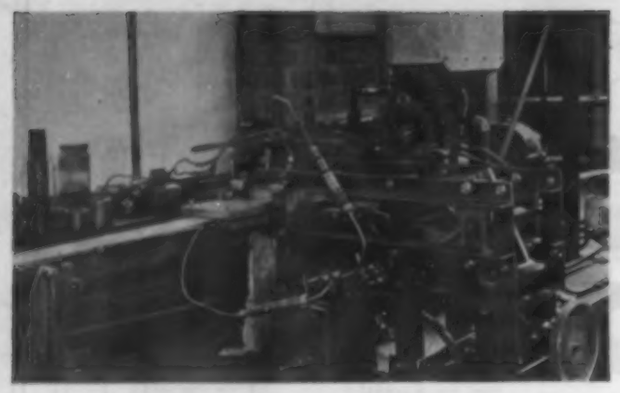
Contamination and poor flow—Under certain conditions, some of the plastic being extruded may be broken down and thereby develop different flow characteristics. This may result in a lumpy wrinkled surface on the extruded piece as shown in the first and second pieces in Fig. 1 which are polystyrene.

A very similar result is obtained if two plastics of the same kind but of different flow characteristics are mixed in the hopper. The addition of scrap to new powder may give a similar effect.

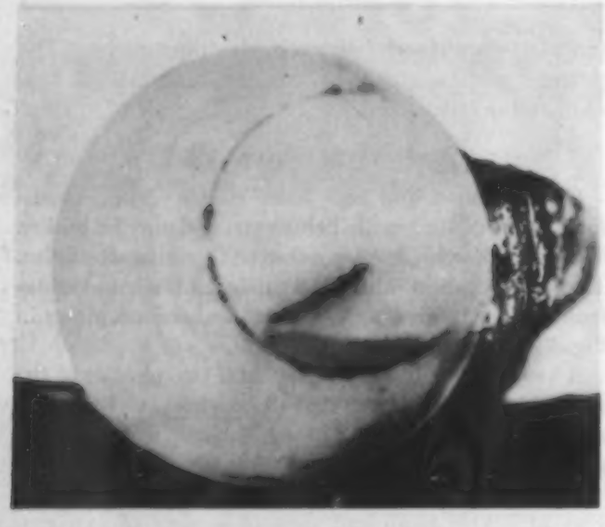
A condition familiar to all extruders is shown in Fig. 21. This is an end view of a piece of extruded acrylic showing a brown spiral down the center. The actual piece was about 8 in. long and 1 $^1/_2$ in. in diameter. In this case, the piece was illuminated very carefully so as to show up the defect. Normally, it cannot be seen through the side. The spiral is very apparent under the conditions of the photograph. It is due, of course, to contamination on the screw caused by careless cleaning of the machine. A very similar con-



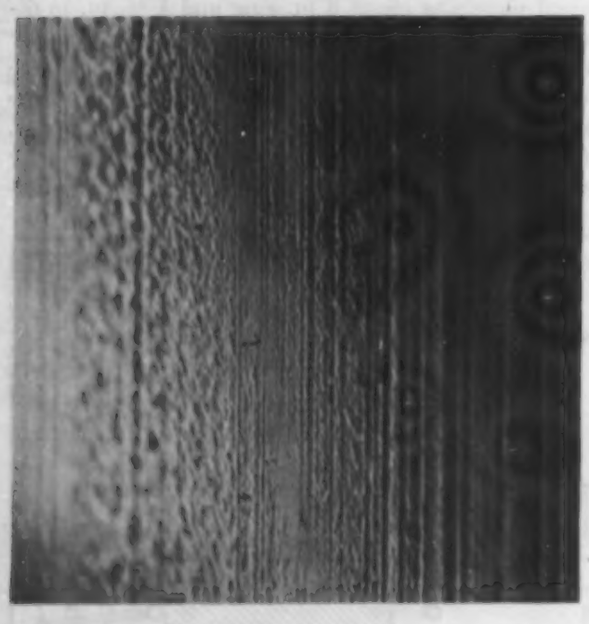
19—Diagram of slipper die: 1) stationary nozzle; 2) oscillating lubricated slipper plates; 3) guides; 4) continuously extruded plastic; 5) stationary side plates



20—Picture showing first experimental slipper die



21—A brownish spiral due to dirt from the extruder



22—A magnified view of a square extruded rod. Surface lines can cause the lack of luster on the surface of an extruded shape

dition results if the powder contains an off-color lubricant which tends to concentrate on the surface of the screw. It can also be caused, along with considerable haze, by the screw cutting against the barrel.

Periodic lines and changes in thickness—Figure 24 illustrates what happens when the extruder is delivering plastic irregularly, giving one cycle each revolution of the screw. Sometimes this may be caused by the way the thread of the screw bites the molding powder at the hopper. It may also be the result of differences in pressure which may be caused by the end of the screw if the die is very close to it. In other cases, a weaving action of the extruder barrel due to a bent screw or faulty drive may produce a similar effect. Figure 24 is, of course, a particularly bad case. The *screwbeat* is plainly shown as the result of the illumination of the surface by a beam of light at grazing angle.

A number of vertical lines are also clearly visible. It can be noted that they occur in the same pattern but not in the same frequency as the screwbeat. Hence, they could not be due to the screw. In fact, they were found to be due to vibration in the take-off device. A different class of surface defects is visible in the round extruded piece photographed in Fig. 25. This defect was caused by some heavy vibration in the factory which shook the piece as it issued from the die. A heavy passing truck or the dropping of a heavy casting will produce this effect. Though obvious in the illustration, the defect could be seen distinctly only by reflected light.

Dull surface—Quite often an extruded piece of methyl methacrylate will, from a distance, appear bright and lustrous but, upon close examination, show a somewhat dulled surface. Examination under a microscope gives surfaces such as shown in Fig. 22.

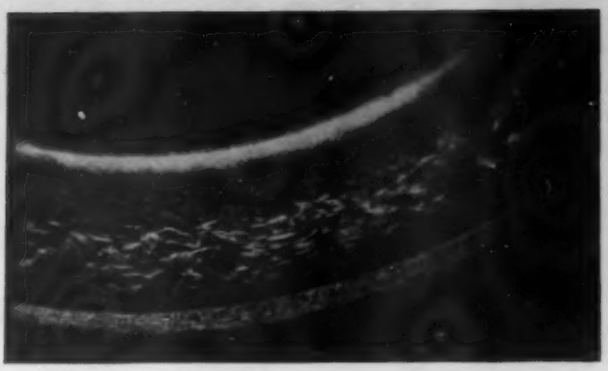
Figure 22 is the side of a square extruded rod magnified many times. Most of the lines are only a few hundred-thousandths of an inch deep. The die was highly polished but the extrusion temperature was low.

Annealing[1]

Necessity for annealing—The composition of plastics is very complicated and many unexpected things may happen. For example, it was noted that a set of *spicules* developed when polystyrene was boiled in water. These are really small flattened bubbles which reflect light from their surface and arrange themselves in the shear planes of the material. Photographed under much magnification and illuminated at a grazing angle, the reflected light gives the appearance of Fig. 23. The illustration is given here only because it indicates points of weakness in the structure which are developed by the action of certain chemicals. It is well known that certain chemicals such as carbon tetrachloride and amyl acetate very seriously weaken the methacrylates.

During the early days of the war, attempts to cement extruded methacrylate shapes to the cast sheets to produce bomber noses resulted in severe cracking and crazing. Our company studied this problem and found

[1] "Annealing of styrene and related resins," by [illegible] Bailey, MODERN PLASTICS 24, 127–131 (Oct. 1946).



23—Spicules of polystyrene caused by boiling in water

that, like polystyrene, the acrylics required annealing Figure 26 shows what happens when a piece of unannealed 1 1/2 in. diameter extruded methacrylate rod is drilled and one drop of carbon tetrachloride applied to the hole. The piece will crack up while you watch. In Fig. 26, one drop of carbon tetrachloride was applied to an axially drilled hole in the left end of the plastic piece and another drop to a radially drilled hole in the right hand end. No fluid was applied to the middle hole.

Proper annealing will prevent the cracking up of the material when solvents or semi-solvents are applied. Hence, pieces which are to be machined or cemented should be annealed. Our company has been able to machine permanently reliable parts of intricate design from methacrylate just as they have from polystyrene.

During the first World War, Adams and Williamson[3] made a study of strains in optical glass produced by cooling from a molten state. Their results are summarized in Fig. 27 in which the numeral is a factor which includes the shape, the thermal conductivity, the specific heat and the elastic constants of the glass. Here h is the rate of temperature change at the surface, a is the radius or half-thickness and x is the distance of the point under consideration from the center. By suitable substitution, the same equations have been found to apply approximately to plastics.

It is not practical to give curves for the methacrylates because there are several grades which require different temperatures. Each grade has its own cycle.

Summary

The extrusion of the methacrylates is a complicated procedure embodying the coordination of many processes. There are three divisions—the direct (and uncertain), the semi-positive and the positive. Only the latter gives consistently accurate shapes, but the number of shapes is limited. A finished product of extrusion if it is to be machined or cemented should also be annealed.

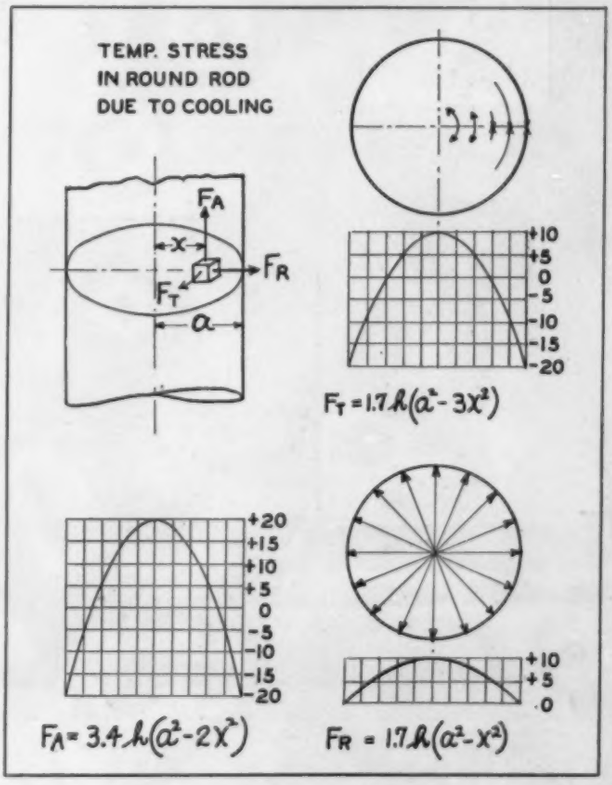
There is yet much to be learned about the process of extruding methacrylate and it is hoped that this article may induce others to add to the rather meager fund of information on the subject.

[3] L. H. Adams and E. D. Williamson, J. Franklin Inst., *190*, 862 (1920).

24—Chatter marks and screw pulsations in tubing

25—Surface defects in plastic extrusion due to vibration

26—Cracks in unannealed drilled sample of methacrylate formed after application of drop of carbon tetrachloride



27—Distribution of stress in a round glass rod due to cooling. F_A stress in axial direction. F_T stress in tangential direction. F_R stress in radial direction

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Production and fabricating possibilities

PHOTOS AND DRAWINGS, COURTESY OWENS-CORNING FIBERGLAS CORP.

1—*This one piece automobile top made of resin impregnated glass cloth is shown just as it comes from the mold*

EXPERIENCE in handling Fiberglas-plastic materials and proof that it was physically *possible* to build an automobile body with them were the real lessons learned from the "Stout Forty-Six," the car with combined glass-fiber plastic body and chassis designed by William B. Stout which attracted so much attention when introduced some months ago. The car did not, as some seemed to feel, give proof that the production of such bodies is now practicable on a mass scale. But it did indicate that Fiberglas-plastic combinations offer the automotive industry a material that can simplify, speed and cut the cost of prototype bodies.

Prototypes of resin-impregnated glass fabric

The construction of such a prototype would be similar in all essentials to the construction of the Stout car body where the designer first fashioned a full-size plaster model. This model was marked off in sections of convenient size. A plaster cast of each of these sections provided female molds in which the glass fiber—mat and fabric—were laid up. Each mold and its lay-up were then sealed in a polyvinyl alcohol bag and a vacuum drawn.

The next step was to place the assembly in a steam-heated oven where it was cured under the differential pressure created by a gentle vacuum for approximately 1 hr. at a temperature of 260° F. When the cure was completed the bag was removed, the cured lay-up was separated from the mold, trimmed and sanded.

In joining the different parts of this car, the surfaces to be joined were roughened and painted with a film of resin. Depending upon the type of joint, strips of resin-impregnated glass fiber cloth were placed over or in the joint and mechanical pressure applied, just sufficient to assure good contact. The joints were cured in the steam-heated oven. Finally, a polished color finish was applied to the body in a manner similar to that employed by the automotive industry in finishing their metal bodies.

Total cost of producing the combined body and chassis was approximately $75,000. Considering that this was an experimental type of construction that had to be engineered from scratch, with no precedents to point the way, we believe the figure was very low.

Reinforced plastic body parts

Another field in which our company believes glass fabric reinforced plastics are ready to perform a service to the automotive industry is in the construction of certain body parts, as distinguished from the construction of an entire body. In this type of work, however, higher material costs must be offset by efficient design which requires a minimum amount of material by reduced tooling costs, reduced assembly costs and corollary savings such as elimination of counterweights, hardware, etc. The trunk lid shown in Figs. 2, 3 and 4 illustrates some of these savings.

An efficiently designed plastic impregnated glass fabric trunk lid for a well-known make of passenger cars weighs 8 lb. as compared with 35 lb. for a similar metal lid. The difference in the amount of material required alone goes far to offset the higher cost of the reinforced plastic material. The weight of the metal lid makes it necessary to employ a counterweight and springs. Otherwise too much exertion would be required to lift it. No counterweight and springs are needed for the reinforced plastic lid. These and other miscellaneous savings make the cost of the two lids virtually equal, and additional savings in the cost of the glass fabric plastic lid might be effected under large-scale production.

Bumpers are another case in point. Curvatures of the original design of a certain bumper made its fabrication out of metal extremely difficult, a difficulty which could be overcome only by fabricating the bumper in three

* Presented before a meeting of American Society of Body Engineers in Detroit on Oct. 25, 1946.
† Vice-President in Charge of Research and Development, Owens-Corning Fiberglas Corporation, Toledo, Ohio.

# of glass fabric reinforced plastics*

by GAMES SLAYTER†

pieces and then welding these three pieces together.

To fabricate a one-piece Fiberglas-plastic bumper of the same design, a plaster female mold was taken directly from a metal bumper. This mold was made in two parts to permit easy removal of the molded piece. Plies of resin-impregnated glass fiber unidirectional fabric—the yarns lying parallel with the length of the bumper—were laid up in the mold, and the mold and laminate sealed in a polyvinyl alcohol bag. Air was drawn from the bag with a vacuum pump. The bag-enclosed mold and laminate were then placed in a hot-air oven for curing at 260° F. for approximately 2 hours. When cured, the bag was stripped off and the resin impregnated glass fiber fabric bumper was removed from the mold. Bumper guards were molded in the same fashion.

Bumper and bumper guards were trimmed, then sanded to remove plaster mold surface irregularities which had been transferred to the laminates. Both units were given a polished painted surface in the usual manner. Tests showed that the strength of the metal and resin-impregnated glass fabric bumpers was the same. While costs of the plastic bumper were out of line on a hand operation basis, it is believed that a well-designed production line operation would tell an entirely different story.

For custom-built cars

When plastic resin-impregnated glass fabric laminates are first used for the construction of whole automotive bodies, the probabilities are that this new material will not be employed for bodies produced in the hundreds of thousands or millions, but for the bodies of custom-built passenger cars and trucks.

Because of the comparatively small numbers in which such bodies are produced, tooling costs are a major element in their final cost. Since high stresses are not applied to the molds in which Fiberglas-plastics are formed, the molds can be of inexpensive construction, making tooling costs low. In the custom body field, resin-impregnated glass fabric also offers a style advantage, for it can be molded in complex curvatures difficult and expensive to achieve with metals. A newly developed method of providing a polished color finish by molding a thick film of pigmented resin on the laminate, makes the finish virtually a part of the laminate itself.

I do not want to leave the impression that present methods of handling resin-impregnated glass fiber fabrics represent more than an early intermediate stage of development. As a matter of fact, experiments are now being made with a new molding method that gives great promise of speeding the process and cutting costs. The method involves the use of a metal mold heated by steam coils, and an expandable rubber plunger. The lay-up to be molded is laid over the mold. The plunger

Wide use of these laminates in automobiles is contingent on the establishment of high-speed assembly lines

is lowered under pressure of approximately 50 p.s.i., pushing the lay-up into the mold. Under pressure, the rubber plunger expands, pressing the lay-up into all the contours of the mold. The lay-up is cured in the mold, thus eliminating the use of the vacuum bag and oven and the need of numerous hand operations.

Assembly line methods

If Fiberglas-plastic combinations are to find widespread use in the automotive industry, high-speed assembly line methods of handling the material must be developed. In this connection, a suggested layout of a production line for the resin-impregnated glass fabric automobile bumpers has been drawn up and is presented in Fig. 5. The production line was laid out to show the flow of materials and the sequence of operations from the material stores to the finished bumpers. The calculations were based on the assumptions which are outlined below:

1. Production rate required, 2 bumpers per minute.
2. Bumper construction, 7 layers of Fiberglas T-35 mat with low-pressure phenolic resin.
3. Colored surface finish to be molded on bumpers during curing operation.
4. Heated female metal molds to be used with flexible male punches.
5. Molding cycle, 8 minutes.

Using the surface area of the bumpers and the mat weight per sq. ft., and allowing for 10 percent waste, it was calculated that 29,000 lb. of mat would be used in a 24 hr. period, and that, on a basis of 45 percent resin content, 23,800 lb. of resin would be used in this same period. On the plant layout these quantities are indicated in receiving stores space. The resin mixing operation would need to handle approximately 1000 lb. per hour, or about 100 gallons. Quality control space is indicated for the purpose of checking incoming materials and the impregnating operation.

Following the resin mixing, the next step is the impregnation of the mat by a dip process. This is followed by a B Stage curing operation which results in a dry, easily handled sheet composed of glass fiber mat fully loaded with resin. With a 44 in. wide mat, weighing

2 3 4

2—An advantage of glass fabric reinforced plastic auto parts is ease with which they are repaired. Here the area in which break occurred has been cut out. 3—A resin impregnated glass cloth patch is laid over cut-out area. 4—After the patch is cured with a heat lamp, surface is refinished. Patch is unnoticeable

approximately 2 oz. per sq. ft., and an impregnating speed of 15 ft. per min., calculations show that 3 impregnating units are needed to handle the required poundage of material. These 3 units are shown operating in parallel on the layout (Fig. 5).

The next step is the cutting of patterns, using steel rule dies. The blanks from this operation are fed onto a conveyor and carried to the point where they are placed in stacks of 7 plies each and loaded onto another conveyor which carries them along the line of presses.

The press operators take these stacks of sheets from the conveyor and place them in the preforming ovens to be heated. This softens the resin and permits preforming and final trimming in the next operation. The preforms then go into the molding presses which operate on an 8 min. cycle. The following operations are carried out:

1. Clean and lubricate mold, 1/4 minute.
2. Spray pigmented resin film on mold surface, 1/4 minute.
3. Load preform into mold, 1/4 minute.
4. Cure, 6 minutes.
5. Eject bumper, 1/4 minute.

With the 8 min. cycle, 16 molds are needed to produce 2 bumpers per minute. In the plant layout, 2 extra molds are shown to allow for rejects, equipment repairs, etc. The preforming units and molds are arranged in pairs, back to back, running in parallel and discharging onto a conveyor system in which are incorporated the buffing, waxing and wrapping operations which complete the production line.

The total cost of the equipment for this proposed plant layout would be approximately $200,000. The total floor space is about 20,000 square feet.

Thus far the emphasis has been on the cost factors that are likely to affect the use of resin-impregnated glass fabric combinations for automotive bodies and automotive body parts. This article would be incomplete, however, if coverage were not given the physical properties of these materials which are responsible for their recognition as an important engineering material.

The combination of glass fibers with resins provides a material that engineers can think of in terms of the metals and their uses. Moreover, it is a material that will not corrode. It possesses a higher strength-weight ratio than the structural metals. These are significant properties, but others are no less important.

Dimensional stability is one of these other properties. Natural fibers and all synthetic fibers made of organic substances absorb moisture to some degree. The absorption of moisture causes them to swell as they become wet, to shrink as they dry, and to lose strength. The swelling and shrinking inevitably effect the dimensional stability of the plastic products in which they are employed as reinforcement.

Glass fibers, being inorganic and being microscopically fine solid glass rods, absorb no moisture. The only moisture they will retain is that which can adhere to the fiber surfaces—a relatively very small amount. Surface treatments of the glass fibers have recently been developed which preferentially replace and repel the adhered film of water.

Because glass fibers will not absorb moisture they will neither shrink nor swell under changes in moisture conditions. In addition, they possess a low coefficient of thermal expansion and are strong enough to resist normal expansion of the resin. The accuracy of dimensions of molded parts can be controlled with high precision because the material has a predictable and very low coefficient of thermal expansion, which is comparable to the metals.

The ability to achieve directional properties is a great advantage in design. If stresses to which the product will be subjected will occur in several directions it is possible to distribute the glass fibers in these directions, in proportion to the amount of stress in each direction. Or, if the principal stress is to come from one direction, it is possible, by arranging the glass fibers in the direction of stress, to attain maximum strength in that direction.

In metals, the modulus of elasticity is not variable, but the modulus of Fiberglas-plastic combinations is controllable over a wide range. This control of the

modulus is a function of the amount of glass and of the orientation of the glass fibers.

Resin-impregnated glass fiber fabric laminates have good dielectric strength. They have no definite yield point, so it is possible to work the material very close to its ultimate strength without permanent deformation. The same characteristic prevents the material from denting when struck a sharp blow—an important consideration in automotive body construction. Because of its fibrous structure, and the consequent scattered distribution of any imperfections, the material will not propagate cracks.

One other property worth mentioning is the ease with which the material can be repaired (Figs. 2, 3 and 4). The area in which a break or crack has occurred is cut out. A patch consisting of resin-impregnated layers of glass fabric is placed over the cut-out area, and the whole part is cured under simple mechanical pressure, with a heat lamp. If time will allow, the patch will cure in 8 hr. under room temperature. When surface refinishing is completed it is practically impossible to detect the presence of the patch.

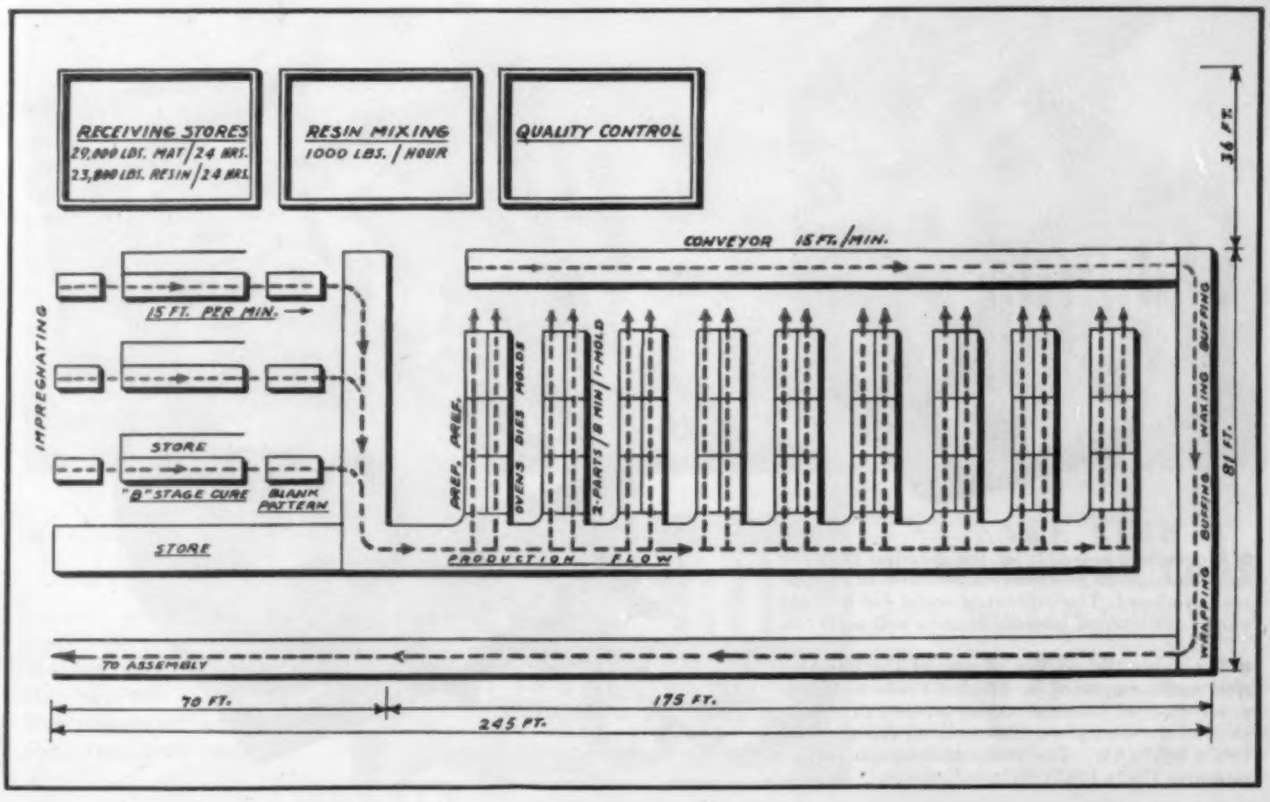
It is, of course, essential that sound engineering techniques be employed in designing, laying up, molding and curing these laminates—whether they are to be used in automotive body structures or in any other application. In any lamillar material you can produce either a balanced or an unbalanced condition, exactly as you can twist a yarn to produce either a balanced or a wild yarn. Just as an unbalanced yarn will be "wild," so an unbalanced laminate will warp.

Controlled heating and curing during the molding operation are also musts. Uneven heating or cooling can result in a type of warping that will be set by the cured resin. Either type of warping, however, is inexcusable so far as resin-impregnated glass fabric laminates are concerned. Good engineering techniques and practice will eliminate any warping, during or after curing.

Resistance to rain abrasion is important in a laminated structure that will be exposed to weathering. Wartime and subsequent experience in the fabrication of radomes had demonstrated that a smooth surface, absence of pinholes and proper wetting between resin and glass result in resin-impregnated glass fabric laminates that will withstand abrasion by high-velocity water droplets such as are encountered by an airplane during a heavy rain storm.

Laboratory rain abrasion tests of these laminates, in which they were subjected to the beating of water drops with velocities of 500 miles an hour, have shown that the laminates possessed greater resistance to such abrasion than 24-St aluminum. Even the highest speed automobile will not encounter such water drop velocities as these, or as are found by an airplane in flight.

5—Here is suggested layout of production line for resin impregnated glass car bumpers. High-speed assembly line methods of handling are necessary for successful use of material. This line was laid out to show the flow of materials and the sequence of operations from material stores to finished bumpers



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The Admiral automatic record player. An interesting feature of this housing is the grille which is molded separately and grooved so that it slips snugly into the open front of the unit.

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● A complete assembly of the Admiral five-tube radio-phonograph combination, the first of its type ever produced. The cabinet is noted for its light weight and integral, lustrous finish as well as its size.

● A graphic illustration of one of the immense steel molds employed by Molded Products for the production of Admiral cabinets. Overall dimensions of a record player cabinet from this mold are 16⅝″ x 14⅜″ x 6⅜″. The radio phonograph cabinet measures 17½″ x 16¾″ x 9¼″.

Removing a 10½ lb. radio-phonograph cabinet from the 576-ton Lake Erie Hydraulic Press. Molded Products Corporation have two of these Lake Erie presses already in service...two more on order.

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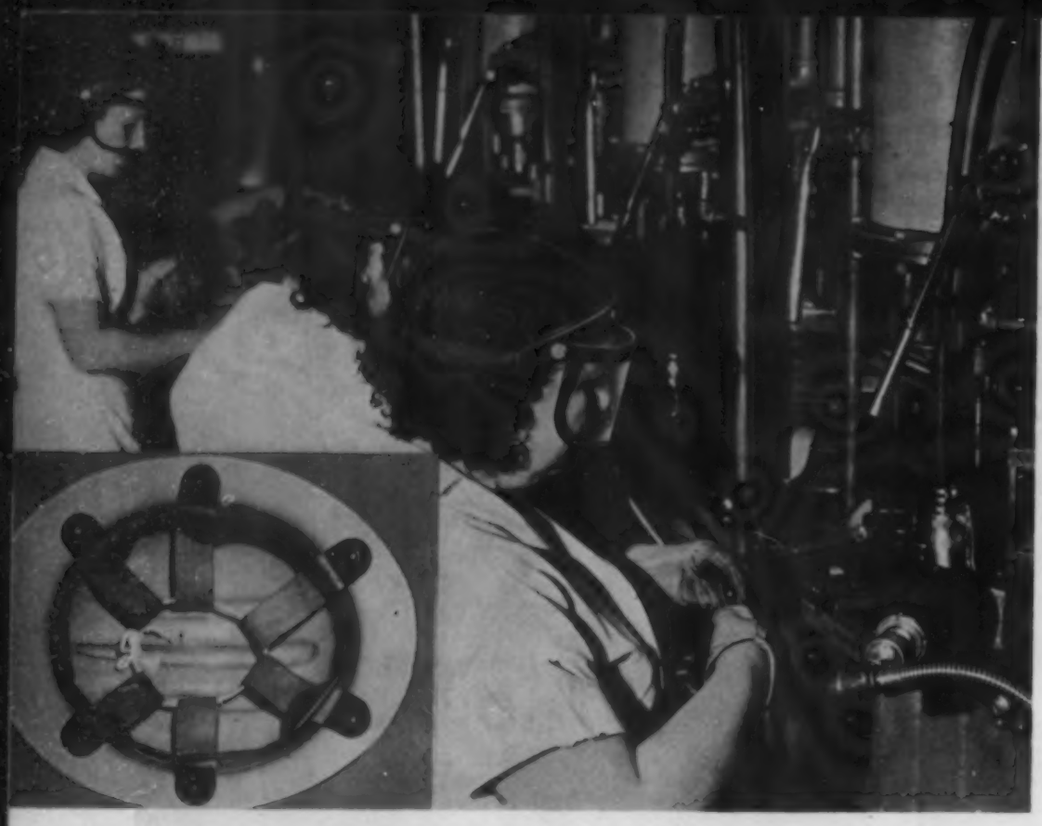

Redesign of a helmet (insert) calling for 8 two-part hangers instead of 4 one-piece units, necessitated developing a new machine with 3 operating stations, each of which comprises 8 small compression presses. Left—After mold is loaded the machine indexes to right and brings the next mold before the operator for unloading and reloading

Tip molding machine

by FRANK MOSS*

OCCASIONALLY a new design of a product, or the redesign of an old product, presents some unforeseen production problems. Such was the case when E. D. Bullard Co. designed an entirely new type of phenolic hanger mounting for its safety helmet.

A new model, a new problem

These hangers consist of fabric strips tipped at either end with plastic to form rigid mountings to insure the firm attachment of the hangers to the hat crowns. Originally each hat contained four such hangers; the new model called for six. Sample moldings and field tests indicated that each hanger should consist of two parts to simplify the job of replacement. Thus, the change in design of the hat not only increased the number of molded phenolic hangers that were needed from 4 to 12 per hat but presented the molder with a more complex molding job.

Designing a machine for the job

Since no machine was in existence that could handle the job just as our company wanted it done, the Products Development Department, in conjunction with our machine shop, set about building a molding machine which would meet the requirements. The unit has worked out so well that a patent has been applied for.

The molding machine has 3 operating stations, each of which is an integral unit comprising 8 small compression presses moving in a circle on a ball-bearing turntable equipped with positive stopping devices for locking each press in its loading position as it moves into place when the table turns. A single air hydraulic cylinder located immediately in front of each operator is used to close each sub-press after loading. The pressure is then locked in by means of a manually operated *catch* and the part in its press moves around the circle, allowing another sub-press to appear before the operator, to be emptied, reloaded and sent on again.

Each sub-press platen is electrically heated with the temperature controlled by thermostats. Current reaches the turrets through the medium of collector rings with carbon brushes placed on the pedestal mount at the underside of the turrets.

Only one hydraulic press is needed to handle all sub-presses on each turntable. As the press closes on the mold, it compresses a heavy spring that acts as a shock-absorber. The platen is then locked in place, no other tension being required during the time of cure.

Number of sub-presses can be increased

Molds of each sub-press may be quickly changed without disturbing the other parts or the adjustment of the machine. While the present machine contains 8 sub-presses, any number may be operated, for each is self-contained except for the pressure cylinder.

* E. D. Bullard Co., San Francisco 4, Calif.

Humidifier-control float, cup, and cap molded by Plastic Industries, Inc., for Cleveland Humidifier Co.

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The heart of this furnace-humidifier control is a Tenite float encased in a transparent Tenite cup.

For the float, the designers sought a material light in weight and dimensionally stable, which would not corrode, leak, or waterlog. For the outer cup, they wanted a substance more shock-resistant than glass, yet transparent, so that the inside water level and drip feed would always be visible. And in each instance, they found the right combination of properties in Tenite. Moreover, this plastic offered economies in production, because of the speed and accuracy with which it could be molded.

The properties which suit Tenite to this purpose have led to its use in many similar products, such as rain gages, manometers, anti-freeze testers, and oil feed cups. For applications in other fields, Tenite provides unlimited color possibilities, electrical and thermal insulating properties, high luster, and a surface that is always pleasant to the touch. For more information about Tenite, write to TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

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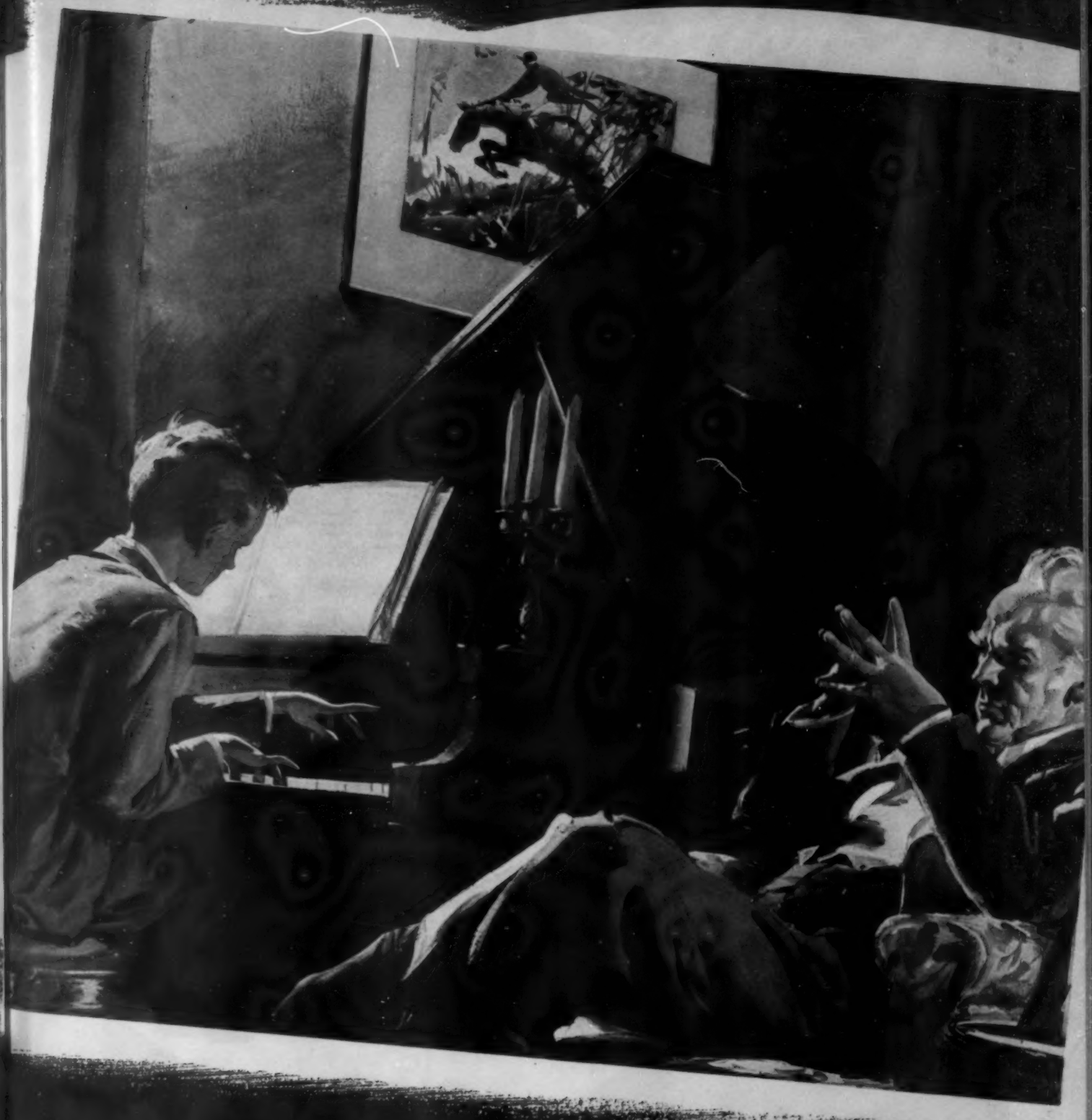
Cyanamid's resins and resin adhesives are known as URAC, MELMAC, MELURAC, and PHENAC. In certain formulations some types form weather-resistant, boil-resistant, or craze-resistant glue lines. Others can be used for low or high pressure bonding. In some instances, these adhesives form strong glue lines in thicknesses up to .020 of an inch. Complete data and technical help are available upon request. American Cyanamid Company, Plastics Division, 32 Rockefeller Plaza, New York 20, N. Y.



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Thermal-expansion stresses in reinforced plastics*

by P. S. TURNER†

A large amount of data has been obtained at the National Bureau of Standards on the application of the formula described in this paper for calculating the coefficients of thermal expansion of mixtures. Plastic compositions with selected coefficients of thermal expansion were calculated successfully by this stress-equilibrium principle to solve numerous problems during the war. Stable bonds are possible between large sections if the thermal coefficients of the component parts are matched. The bond under such conditions is not seriously affected by extreme temperature changes. The method of computing the thermal coefficients of mixtures is applicable to plastic compositions in general and particularly to those problems involved with reinforced plastics.

THIS report describes a method of compounding a plastic or other mixture or compositions to provide a material having a predetermined desired coefficient of thermal expansion. Heretofore, in the preparation of plastics, it has been found practically impossible to produce a satisfactory bond between a plastic and a metal facing or other metal reinforcement. This is due for the most part to the difference in coefficients of expansion of the materials; the plastics have relatively high coefficients of expansion as compared with those of metals. Because of the differential expansion, forces created upon changes in temperature have been such as to prevent a satisfactory bond being obtained between metals and plastics except where plastics of a flexible rubberlike or gummy type are used. Even in the bonding of foils of tin, lead, aluminum, etc., to cardboard or paper for containers, gummy or tacky plastics only have been used.

The problem of obtaining bonds between plastics or other adhesives and various materials is considered as being substantially the same problem as that of removing or eliminating concentrated stresses at the boundaries. If internal stress concentrations can be removed, the full strength of the adhesive can be developed to resist external loads.

Bonds produced by adhesives can be divided into two general classes: 1) the rubbery or yielding bond, and 2) the rigid bond. In the first category are found most thermoplastic cements, rubber cements, and combinations of thin rubber layers and cements. Adhesives of this class have been found to provide durable bonds between dissimilar materials at moderate temperatures. The rigid or high modulus bond has generally been found unsatisfactory for such applications. A possible exception is found in the use of cold-setting cements of the phenol-formaldehyde and urea-formaldehyde types. The advantages of the first class over the second disappear at reduced temperatures where the adhesive loses its ability to eliminate stress concentrations by yielding with the dimensional changes of the materials bonded. The rigid bond, if it can be obtained, is superior for many purposes to the yielding bond because it produces a stronger and less yielding product. For composite structural materials subjected to extreme temperature changes a stable rigid bond is imperative.

In attempting to bond various materials together, it has been found that materials having widely different coefficients of expansion cannot be bonded with any rigid cement available. Certain thermoplastic adhesives produce satisfactory bonds at ordinary temperatures, but fail at low temperatures when the bond becomes rigid and is no longer able to yield to changes in dimension of the materials bonded. Certain rubber cements fall into the classification of bonds which are soft enough to yield with changes in dimensions. These yielding bonds, however, do not produce the rigidity required for structural applications and fail at low temperatures for the same reason that rigid plastic

* Abridged from an N.A.C.A. Report entitled "The problem of thermal-expansion stresses in reinforced plastics" by P. S. Turner.

† Deceased, National Bureau of Standards. The experimental work on this project was sponsored by and conducted with the financial assistance of the National Advisory Committee for Aeronautics, upon the recommendation of their Subcommittee on Wood and Plastics for Aircraft.

bonds fail at ordinary temperatures; namely, expansion: contraction rate differences with temperature changes.

These failures are caused by stresses resulting from differential expansion or contraction. These forces can be reduced by one or more of the following factors.

Bond strengths

An analysis of the factors responsible for the production of stress concentrations in a rigid bond must include the following:

1. The thickness of the materials bonded.
2. The thickness of the adhesive layer.
3. The modulus of elasticity of all components.
4. Changes in dimensions with changes in moisture content for all materials.
5. Changes in temperature to be found in service.
6. Coefficients of linear thermal expansion of all materials.
7. Pressure of application.

1. *Thickness of materials bonded*—It is evident that if the thickness of the materials bonded approaches zero, stresses set up by any other combination of factors must approach zero also. Accordingly, it has been found possible to bond thin metal foils to other materials. A method of eliminating stresses by this means would, however, have very limited practical application. This stress-reducing factor is utilized in the production of mechanical mixtures of materials of microscopic size or in the form of fine filaments, which are incompatible on a larger scale.

2. *Thickness of adhesive*—In bonding two pieces of the same material the stresses set up in the bond as the result of restrained dimensional changes in the bonding material would be proportional to the thickness of the bond. It has long been recognized that thin adhesive layers produce stronger bonds than thicker ones.

3. *Modulus of elasticity*—If the modulus of elasticity of any one of two adjacent materials is zero, the stresses set up between them must be zero. This is essentially achieved by bonds which yield readily and offer little resistance to static loads whether produced internally or externally.

4. *Moisture content*—The problem of bonding materials having different dimensional stability with changes in relative humidity can be reduced, if not eliminated, if the surface of the combination is impervious to moisture. At the time of bonding or at the end of the bonding operation the material or materials sensitive to changes in humidity can be made to contain the normal amount of water present under average conditions. No completely satisfactory solution to this aspect of bonding has been found.

5. *Temperature*—Changes in temperature cannot be eliminated in any practical application. For cold-setting phenol-formaldehyde and urea-formaldehyde cements the effect of temperature changes is minimized by bonding at temperatures close to those encountered in service.

6. *Thermal expansion*—From the standpoint of the thermal stresses produced, the problem of bonding two different materials becomes identical with the problem of bonding two pieces of the same material provided the coefficients of thermal expansion of the two materials are the same. A further reduction in stresses can be achieved if the bonding agent has the same coefficient of thermal expansion as the materials which are bonded.

A bond between materials having different coefficients of expansion would have to withstand the shear stresses produced by the differential expansion or contraction experienced within the range of temperatures encountered. Bonds can sometimes be maintained if the materials bonded are thin enough to permit the relief of stresses by bending or warping, either of which is undesirable. The bonding strength exhibited by a particular adhesive is the additional load which, added to the internal concentrated stresses, is sufficient to disrupt the material. In some cases this additional load is zero and the materials are said not to bond.

7. *Pressure of application*—When two materials are bonded together at high pressures, strains are produced at the bond when the pressure is released. This strain is proportional to the ratio of the moduli of elasticity of the two components. The lowest pressure feasible should be used to produce bonds with the lowest internal strains.

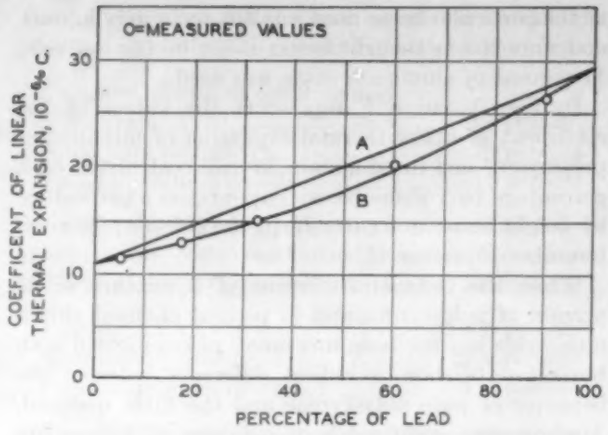
The logical conclusion to be drawn from the foregoing discussion is that stable rigid bonds are possible over a wide range of temperatures if the thermal-expansion coefficients of the component parts are matched. An example of the results to be expected is furnished by the combination of concrete and steel which individually have practically equal coefficients of thermal expansion and contraction. It is known that certain proportions of cement, sand and stone produce optimum results.

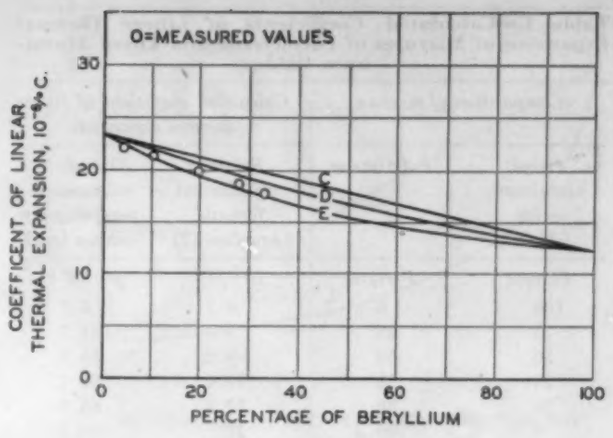
Various methods have been used in other fields to predetermine the thermal-expansion coefficients of mixtures, such as alloys, glasses, etc. Some of these methods appear to work satisfactorily in limited applications. Notable among these are weighted averages based on the thermal-expansion coefficients of the components and their proportions either by weight or by volume. These methods do not, however, give satisfactory results for plastic compositions.

Calculating coefficients of thermal expansion

It seems reasonable to expect that the coefficient of thermal expansion of a mixture is a function of the relative compressibilities as well as the thermal-expansion coefficients and the proportions of the components. The following formula for the coefficient of thermal expansion for a mixture (α_r) takes into account relative compressibilities of components (*1*, *2*, ... *n*).

$$\alpha_r = \frac{\frac{\alpha_1 P_1 K_1}{d_1} + \frac{\alpha_2 P_2 K_2}{d_2} + \ldots + \frac{\alpha_n P_n K_n}{d_n}}{\frac{P_1 K_1}{d_1} + \frac{P_2 K_2}{d_2} + \ldots\ldots + \frac{P_n K_n}{d_n}} \qquad (1)$$





1—The thermal-expansion coefficients of lead-antimony mixture. Curve A: percentage by weight calculation. Curve B: percentage by volume or stress equilibrium calculation. 2—Thermal expansion coefficients of the beryllium-aluminum alloys. Curve C: percentage by weight calculation. Curve D: percentage by volume calculation. Curve E: stress equilibrium calculation

The symbols employed in this equation are as follows:

α = coefficient of linear thermal expansion
P = fraction or percent by weight
K = bulk modulus = 1/bulk compressibility
d = density

It is apparent by inspection that Equation (1) based on stress equilibrium reduces to a percentage by volume calculation if the ingredients have the same bulk moduli. If the ingredients have the same modulus to weight ratios, the calculation amounts to a percentage by weight interpolation.

Equation (1) has been verified with experimental values of several metallic mixtures. The thermal-expansion coefficients calculated according to Equation (1) for several mixtures of lead and antimony and of beryllium[1] and aluminum are compared with the measured values in Figs. 1 and 2.

Applications to plastic compositions

It has been found that the size and shape of the filler particles in plastic mixtures have an effect on the resultant coefficient of expansion of the mixture. The equations derived do not take this phenomenon into consideration. Difficulty is also encountered because the moduli of some materials are not available. To solve these problems, Equation (1) is modified by substituting an empirically determined constant C for K/d for each material. This constant C is interpreted as proportional to the modulus-density ratio rather than being equal to it. The proportionality factor is dependent on the shape and size of the particles and on the distribution of the material in the matrix. It is assumed that the constant C for each specific filler and each plastic material is independent of the other components of a mixture if the ingredients are evenly distributed. This modified equation has been used successfully in several investigations. The use of this technique, and the effects of the shape and size of fillers have been described in another report.[2]

In studies of the physical properties of reinforced plastics it has been found that the strongest materials were produced by oriented fibers in thermosetting resins. The material fabricated in this manner is essentially non-isotropic in all of its properties and has different coefficients of expansion depending on the direction of the fibers in the test specimen. Materials having isotropic properties can be obtained by random distribution or by planned orientation. Solutions for any property must take into consideration the orientation of the filler as well as the percentage composition.

For a mixture whose components have nearly equal values of Poisson's ratio, the bulk moduli are nearly proportional to the corresponding Young's moduli. For such mixtures Young's modulus may therefore be substituted for bulk modulus in Equation (1) to yield the following expression for the thermal-expansion coefficient of a mixture.

$$\alpha_r = \frac{\frac{\alpha_1 P_1 E_1}{d_1} + \frac{\alpha_2 P_2 E_2}{d_2} + \ldots + \frac{\alpha_n P_n E_n}{d_n}}{\frac{P_1 E_1}{d_1} + \frac{P_2 E_2}{d_2} + \ldots + \frac{P_n E_n}{d_n}} \qquad (2)$$

Thus, in many cases where the bulk moduli are not available, Equation (2) may be used instead of Equation (1). The following experiments on a mixture of polystyrene and aluminum oxide illustrate the reasonably successful application of Equation (2).

Mixture of styrene and aluminum oxide

The applicability of the formula is illustrated by the behavior of brass inserts in a mixture of styrene resin

[1] Mixtures of Be and Al apparently form a mechanical mixture but no value for the bulk modulus or bulk compressibility was available. From the thermal coefficient, 17.8 × 10⁻⁶/° C., of a known mixture containing 32.7 percent Be and 66.3 percent Al, and with reported densities and thermal coefficients of the ingredients, the bulk modulus of Be was calculated from Equation (1) to be 15.2 × 10⁶ p.s.i. Using this value the thermal coefficients of other mixtures of Be and Al were calculated with the results shown in Fig. 2 in comparison with the reported values.

[2] "Fairing compositions for aircraft surfaces" by Philip S. Turner, Jewel Doran and Frank W. Reinhart, National Bureau of Standards. N.A.C.A. Technical Note No. 958 (Nov. 1944).

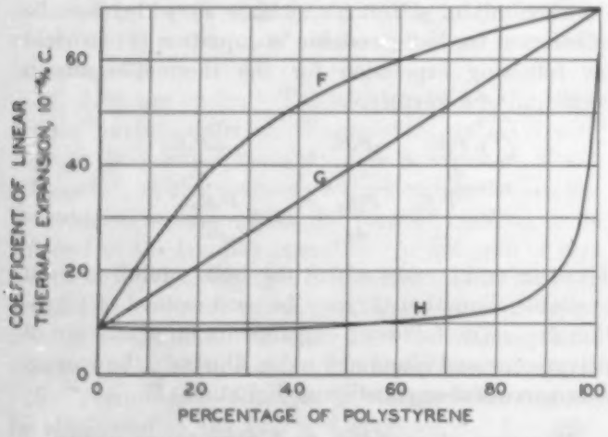
Table I.—Calculated Coefficients of Linear Thermal Expansion of Mixtures of Polystyrene and Fused Aluminum Oxide

Composition of mixture		*Calculated coefficient of linear thermal expansion*	
Fused aluminum oxide (Al_2O_3)	*Polystyrene*	*By stress equilibrium formula, equation (2)*	*By rule of mixtures on percentage by volume basis*
Percent	*Percent*	*10^{-6}/° C.*	*10^{-6}/° C.*
100	0	8.7	8.7
75	25	9.0	41.7
50	50	9.6	56.3
25	75	11.7	64.7
20	80	12.5	65.9
9.7	90.3	17	68.2
5	95	23.2	69.1
0	100	70	70

with fused aluminum oxide powder. Brass inserts in ordinary polystyrene cause it to crack because of the different coefficients of thermal expansion. The coefficient of linear thermal expansion of polystyrene is approximately 70 × 10^{-6}/° C.; that of brass is approximately 17 × 10^{-6}/° C.

Fused aluminum oxide was chosen for use in the mixture because it has a low coefficient of linear thermal expansion (8.7 × 10^{-6}/° C.) and a high modulus of elasticity compared to its density. Its choice for use with polystyrene was also determined in part by its desirable electrical properties. There was no appreciable change in the excellent electrical resistance of polystyrene when the aluminum oxide filler was added.

The data in Table I for the coefficients of linear thermal expansion of mixtures of polystyrene and fused aluminum oxide, calculated according to the stress-equilibrium formula, show that approximately 90 percent of polystyrene and 10 percent of aluminum oxide would be required to match the coefficient of linear thermal expansion of brass. Since the coefficient of the particular brass used was not accurately known, and since it was thought better to err on the low side, 11 percent of aluminum oxide was used.



3—Thermal expansion coefficients of polystyrene and the fused aluminum oxide mixtures. Curve F: percentage by volume calculation. Curve G: percentage by weight calculation. Curve H: stress equilibrium calculation

In Fig. 3, curve *F* represents the values of the coefficient of linear thermal expansion of mixtures of polystyrene and fused aluminum oxide calculated on a percentage by volume basis; curve *G*, on a percentage by weight basis; and curve *H*, by the stress-equilibrium formula—Equation (2).

While the thermal coefficient of a mixture of 89 percent of polystyrene and 11 percent of fused aluminum oxide has not been measured, pieces molded with brass inserts show a radical difference between the behavior of pure polystyrene and the filled material. Analysis with polarized light indicates that there are stresses in the pure polystyrene concentrated at the boundaries between the brass and polystyrene, and these are sufficient to rupture the polystyrene. With 11 percent of fused aluminum oxide filler no such stress concentrations occur and there is no evidence that the filled styrene has fractured. The brass was sufficiently well bonded to the polystyrene mixture to permit sawing and machining of the composite material.

The conventional methods of calculation would yield for this composition a value of 63 × 10^{-6}/° C. for the coefficient of linear thermal expansion on a percentage by weight basis, which would indicate that the material should behave very nearly the same as the pure polystyrene. The behavior of the material, however, indicates that its coefficient is close to that of brass, which value was used to predetermine the composition by the use of the stress-equilibrium formula.

Compositions for filling rivet depressions

Fairing compositions for aluminum, used to fill in depressions on aircraft caused by riveting, were tested by exposure to Washington weather for 1 year. An enigma developed when it was found that compositions having generally good weathering characteristics did not stand up well in this application. The calculated values for coefficients of linear thermal expansion of the various compositions are as follows:

Material	*Calculated coefficient*
1. Cellulose nitrate + 25 percent aluminum pigment	44.2 × 10^{-6}/° C.
2. Cellulose acetate butyrate + 25 percent aluminum pigment	45.2 × 10^{-6}/° C.
3. Vinylite AYAF + 30 percent aluminum pigment	30.6 × 10^{-6}/° C.

The coefficient of linear thermal expansion of aluminum is 24 × 10^{-6}/° C. Composition 3, which happened to come closest to the coefficient of aluminum, gave the best bond.

Inasmuch as the lowest coefficient obtainable with aluminum pigment is 24 × 10^{-6}/° C. for 100 percent pigment, it becomes necessary to add another ingredient with a coefficient below aluminum to the plastic in order to obtain matched thermal coefficients.

The following proportions were calculated for cellulose plastic compositions to reasonably match aluminum:

Cellulose nitrate or cellulose acetate butyrate	66 percent
Aluminum pigment	20 percent
Fused aluminum oxide	14 percent

Similarly, the following proportions were calculated for a vinyl acetate resin composition to match its coefficient of linear thermal expansion with that of aluminum:

Vinylite AYAF resin	74.6 percent
Aluminum pigment	20.0 percent
Fused aluminum oxide	5.4 percent

Phenol in resin and glass fiber mixtures

Approximate values for the properties of glass and phenol-formaldehyde resin required for use in the stress-equilibrium formula are as follows:

Young's modulus of elasticity	
For glass	11×10^6 p.s.i.
For phenolic resin	1×10^6 p.s.i.
Coefficient of linear thermal expansion	
For glass	7.44×10^{-6}/° C.
For phenolic resin	59×10^{-6}/° C.
Density (g./cm.^{3})	
For glass	2.56
For phenolic resin	1.30

In order to simplify the calculation of the coefficients of linear thermal expansion of mixtures of these materials, Equation (2) can be written in a form consolidating the physical constants:

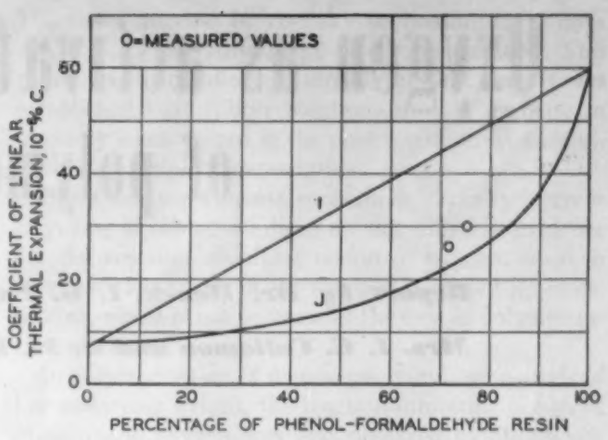
$$\alpha_r = \frac{a_1P_1 + a_2P_2 \ldots + a_nP_n}{b_1P_1 + b_2P_2 \ldots + b_nP_n} \qquad (3)$$

where a and b are constants for specific materials for a specific temperature range. The approximate values for these constants for phenol-formaldehyde resin and glass figured from physical constants listed above are:

	Glass	*Phenol-formaldehyde resin*
a	29.1	45.4
$b \times 10^6$	3.91	0.77

In Fig. 4, curve *I* represents a percentage by weight interpolation for the glass-resin mixtures; curve *J* is calculated by the stress-equilibrium formula. Measured values of the coefficients of linear thermal expansion of two compositions shown in Table II are plotted according to the percentage of the resin in the mixture. These samples contained approximately 4 percent of starch which was neglected in calculating curve *J*. The theoretical coefficients for the compositions containing starch were not calculated because the required physical constants are not known. The experimental points fall much closer to the curve *J* calculated by the formula than to curve *I*. The curve on a percentage by weight basis would be similar to curve *F* in Fig. 3 and would be still further from predicting the actual result.

The addition of metal faces to reinforced plastics may be desired in order to take advantage of the high



4—The thermal expansion coefficients of phenol-formaldehyde resin and glass fiber mixtures containing approximately 4 percent of starch. Curve I: percentage by weight calculation (not including starch). Curve J: stress equilibrium calculation (not including starch)

modulus properties of metals, as in an I beam, or to obtain a facing impermeable to moisture. To do this effectively it would be necessary to have matched thermal-expansion coefficients in order to insure satisfactory bonds. To calculate the mixture of glass fiber and phenolic resin required to match aluminum alloy 24S, whose coefficient of linear thermal expansion is 23×10^{-6}/° C., let α_r in Equation (3) equal this latter value and solve for the percentage of glass; thus:

$$23 \times 10^{-6} = \frac{29.1P_g + 45.4(100 - P_g)}{3.91P_g + 0.77(100 - P_g)} \times 10^{-6}$$

The required percentage of glass is found to be 31.3.

The indicated glass content is seen to be a little higher than was present in the panels prepared with glass-fiber mat, phenolic resin and starch, whose thermal-expansion coefficients are reported in Table III. These panels were fabricated between aluminum alloy 24S faces. It was found possible to remove the metal face without seriously damaging it or the core material. The metal faces (*Please turn to page 214*)

Table II.—Coefficients of Linear Thermal Expansion of Mixtures of Glass Fibers, Phenolic Resin and Starch

Composition of mixture			*Coefficient of linear thermal expansion*	
Glass fiber	*Phenol-formaldehyde resin (Bakelite XC-11749)*	*Starch*	*Calculated by stress equilibrium formula, Equation (2)*	*Measured*
Percent	*Percent*	*Percent*	*10^{-6}/° C.*	*10^{-6}/° C.*
100	0	...	7.44	...
50	50	...	14.2	...
25.2	70.8	4	...	26.0
25	75	...	23.6	...
22.2	73.8	4	...	29.9
10	90	...	37.4	...
0	100	...	60	...

Oxygen as activator and deactivator of polymerization*†

Report by Dr. Heuck, I. G. Farbenindustrie A.-G., translated by Mrs. I. G. Callomon and G. M. Kline, National Bureau of Standards

SUMMARY

Activation of low molecular weight monomers is initiated by peroxides or atomic oxygen liberated from these peroxides by water or hydrogen ions of the aqueous dispersion agent—depending on the reaction temperature. Opposed to the activating reaction there is a deactivating reaction which occurs when molecular oxygen adds itself to the activated monomer.

The deactivating reaction has a marked effect on the induction period in polymerization. Exclusion of oxygen, normally present in uncontrolled amount in the reaction vessel and dissolved in the aqueous phase, has led to more reproducible results and a more uniform polymer. The oxygen content of water depends on various factors, especially on temperature. This fact might perhaps explain the often observed varying onset of polymerization in otherwise identical compositions. On the basis of this new finding, it is necessary to watch the chemicals used in emulsion polymerization for the existence of impurities having reducing action. The presence of a very small amount of a reducing agent can shorten the induction period and decrease the K-value.

The *moloxides*, which are either present in the monomer or develop in contact with air, decompose only at higher temperatures than the peroxides (potassium persulfate or hydrogen peroxide) used as activators. Therefore, the decrease in the induction period becomes more evident in comparative tests made at low temperatures.

THE reaction-accelerating action of oxygen and oxygen-yielding compounds during polymerization has been a recognized fact for many years. Several observations during the last few years both within and without the I. G. laboratories concerning the reaction-inhibiting action of oxygen during polymerization reactions led to an investigation of this unexplained contrasting behavior of oxygen, especially with regard to emulsion polymerization.

Oxygen as activator during polymerization

The activating action of oxygen or peroxides during polymerization is generally known. The theory was first stated by Engler and Weissberg[1] in 1904. Engler assumed that every polymerization process has a parallel oxidation process. Lautenschlaeger[2] in 1913 conducted a whole series of polymerization experiments with peroxides such as benzoyl peroxide, phellandrene peroxide and phenylethylene peroxide. The influence of these activators in the bulk polymerization of styrene, tetrahydrobenzene and terpenes was studied at a polymerization temperature of 80° C.

The first patent[3] on this subject describes the preliminary treatment of isoprene with air and subsequent polymerization. Another patent[4] covers bulk polymerization of butadiene with peroxides or ozonides. A later patent[5] mentions briefly the polymerization of butadiene with peroxides or ozonides as activators.

The use of oxygen and oxygen-yielding compounds as activators for vinyl compounds was first made known in 1914; the patent[6] describes bulk polymerization of vinyl esters with organic peroxides, ozonides and perborates as polymerization accelerating agents. The special polymerization of vinyl halides by the bulk process with peroxides (benzoyl peroxide, sodium perborate) is covered in a later patent.[7] Bulk polymerization of acrylic esters with peroxides as activators was patented by Rohm and Haas.[8]

For emulsion polymerization,[9] which has now become so important, the use of peroxides as activators was first patented for the case of butadiene.[10] This was followed by patents for emulsion polymerization of acrylic esters[11] and styrene[12] with the aforementioned activators.

The results of these investigations can be summarized as follows:

1. The polymerization reaction in both the bulk and emulsion processes is considerably accelerated by per-

* The Department of Commerce is merely distributing this technical information which has come into its hands from captured German territory. This information should be made available to all United States citizens interested in it but use of it by anyone must be and is at one's own risk in so far as the United States or foreign patent violations are concerned.

† The investigations summarized in this report were started in the Research Laboratory of Buna-Werke G. m. b. H., Schkopau, and were continued in the Z. K.-Laboratory Z, Ludwigshafen (Dr. Hopff), utilizing the experience of this latter laboratory in this same field. The report was presented at the 24th Kako (Plastics Committee) meeting in Frankfurt on Dec. 18, 1940.

oxide compounds as activators. However, in many instances a so-called induction period could be observed, that is, the actual polymerization started only after a few hours' delay; no explanation existed for this phenomenon. It is met with especially in emulsion polymerization which is usually carried out at relatively low temperatures.

2. The use of the aforementioned activators to accelerate the polymerization reaction, results in decreased K-values; this has been established in numerous tests made with various vinyl compounds. The decrease becomes greater with increased amounts of peroxide. Table I shows the decreases in K-value of emulsion polymers of styrene,[13] with increasing amounts of potassium persulfate as polymerization accelerator. Staudinger,[14] Schulz and Husemann[15] have shown that increasing amounts of benzoyl peroxide in bulk polymerization of styrene result not only in a decrease in molecular weight but also in a decrease in the so-called Km constant, which is attributable to an increase in the degree of branching.

Oxygen as deactivator during polymerization

The deactivating action of atmospheric oxygen during polymerization has been mentioned frequently in the literature. The first such observation is that by Porrit[16] in his investigations of gel formation of rubber solution under the influence of ultraviolet light. He discovered that gelling occurs when a rubber-benzene solution is irradiated in the absence of air whereas it does not occur when the same experiment is conducted in the presence of air.

Porrit's experiments were checked and verified by Pummerer and Kehlen,[17] who found that the gelling time of rubber solutions irradiated in the presence of unpurified cylinder nitrogen was about double that in nitrogen purified according to the Kautsky method.

	In highly purified nitrogen	*In cylinder nitrogen, containing ozygen*
Gelling time of irradiated rubber solutions, min.	50; 60	120

In this connection, an experiment by Kroepelin and Brumshagen[18] is worth mentioning; they showed that a solution of alkaline-purified sol-rubber underwent a $1^1/_2$ times increase in viscosity on heating for 5 days at 60° C. in an atmosphere of carbon dioxide. This result was astounding, as already at that time it was established that rubber solutions show a decrease in viscosity when heated in the presence of air as a consequence of incipient degradation.

But these experiments concerning viscosity increase or gelling of rubber solutions are not sufficient evidence for the reaction-inhibiting action of oxygen, since in this case the change in the solution is caused by cross-linking, which is not necessarily the case in polymerization reaction.

In polymerization of monomeric vinyl compounds of low molecular weight, the reaction-inhibiting action of atmospheric oxygen was first observed by Staudinger and Schwalbach[19] in polymerizing vinyl acetate:

Gas in polymerization	*Polymerization observation using:*		
	Ultraviolet light at 20° C.	*Heat*	
		100° C.	*180° C.*
Air	−	−	−
Carbon dioxide or nitrogen (no oxygen)	+	+	+

Messrs. Staudinger and Schwalbach explain this strange difference in the behavior of vinyl acetate during polymerization on the basis that in polymerization, conducted at the low temperature with ultraviolet light, the activated vinyl acetate molecules are deactivated by the atmospheric oxygen. This deactivation supposedly does not occur during polymerization with ultraviolet light in an atmosphere of nitrogen or carbon dioxide. Staudinger and Schwalbach's tests showed further that during polymerization of vinyl acetate at 100° C. the polymerization can be accelerated by small amounts of peroxide, either contained in the vinyl acetate or newly formed as a consequence of the entrance of air. Vinyl acetate distilled in an atmosphere of nitrogen with complete exclusion of air did not polmerize, even when heated at 100° C. for 6 weeks. Under these conditions, polymerization started only at 180° C.

During polymerization of vinyl acetate by means of ultraviolet light at room temperature, atmospheric oxygen acts decidedly anticatalytically. During bulk polymerization in the presence of air at 100° C. or with the addition of peroxides as polymerization accelerators (heat polymerization), vinyl acetate is polymerized without special difficulty.

Likewise, in the case of acrylic acid and its esters, Staudinger and Kohlschuetter[20] observed an inhibiting action of atmospheric oxygen in polymerization with ultraviolet light. In an atmosphere of nitrogen or carbon dioxide, this polymerization occurred much faster than in the presence of atmospheric oxygen. Staudinger and Urech[21] also demonstrated that methyl acrylate heated at 100° C. in a glass tube without oxygen for 3 days does not polymerize. But with air allowed to enter, polymerization takes place very briskly

Table I.—Influence of Amount of Potassium Persulfate on K-Value of Styrene Emulsion Polymer

Test No.	*Amount of potassium persulfate*		*Yield*	*K-value observed*	*K-value average*
	g.	*%*	*%*		
18	0.25	0.05	94.6	152	149
18a	0.25	0.05	94.6	146	
19	0.50	0.10	97.4	139	137
19a	0.50	0.10	98.8	135.5	
20	1.00	0.20	97.2	118	120
20a	1.00	0.20	98.6	121	
21	2.00	0.40	97.4	105	107.5
21a	2.00	0.40	99.0	110	

within one hour. On the basis of these experiments it has been proposed[22] that the distillation of acrylic acid, which has always been difficult because the column becomes clogged through spontaneous polymerization, be conducted in the presence of small amounts of air as a stabilizer.

Similar results completely confirming these observations were obtained in experiments concerning the polymerization of vinyl bromide.[23] Summarizing these, it can be stated that in polymerization conducted with ultraviolet light, usually at room temperature, oxygen acts as a deactivator. In heat polymerization at higher reaction temperatures it acts as an activator for the polymerization reaction.

During the last 15 years, I. G. has carried out many investigations in the field of polymerization. The first important observation was that the polymerization of butadiene, in the presence of small amounts of phenylhydrazine derivatives and peroxide, yields benzene-soluble butadiene polymerization products.[24] A later patent application[25] describes polymerization of vinyl compounds in the presence of sodium hydrosulfite. Experiments in 1936 concerning emulsion polymerization of β-chlorobutadiene showed that the addition of sodium hydrosulfite results in a faster start and a smoother course of polymerization, even at lower temperatures. Products obtained according to this process showed very remarkable properties in vulcanization tests.[26] Later on, this process was further investigated and covered by a patent application.[27]

Logemann[28] later observed the inhibiting action of atmospheric oxygen in emulsion polymerization of styrene. Our experiments confirmed Logemann's results.[29] The difference in the polymerization in the case of emulsion polymerization of styrene becomes especially evident in tests carried out at room temperature. However, at a polymerization temperature of 50 to 70° C., this effect is hardly noticeable. Our latest polymerization tests conducted in the Z. K. laboratory confirm these findings also in the case of emulsion polymerization of vinyl chloride, acrylonitrile, acrylic esters and butadiene.

On the basis of this summary of the results of tests made in so many laboratories, one is justified in recognizing, in general, the action of oxygen as both an activator and a deactivator in the polymerization process.

Reaction mechanism of polymerization

To explain the apparent contradiction in the behavior of oxygen during polymerization—acting under certain conditions as activator, under others as deactivator—it is necessary to discuss briefly the reaction mechanism of polymerization according to our present knowledge. According to Staudinger[30] the polymerization process is a chain reaction occurring in three reaction stages, similar to those in the chlorine-hydrogen gas reaction studied by Bodenstein and Nernst:[31]

I. Initiation reaction
$$Cl_2 \longrightarrow 2Cl$$
$$H_2 \longrightarrow 2H$$

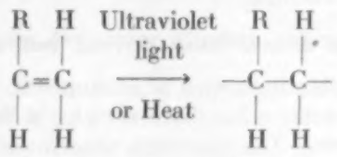
II. Propagation reaction
$$Cl + H_2 \longrightarrow HCl + H$$
$$H + Cl_2 \longrightarrow HCl + Cl$$

III. Termination reaction
$$Cl + H \longrightarrow HCl$$
$$H + H \longrightarrow H_2$$
$$Cl + Cl \longrightarrow Cl_2$$

In polymerization the initiation reaction,[32] i.e., the activation of monomeric compounds of low molecular weight, can be started by:

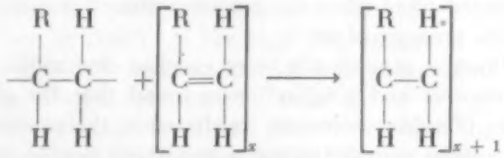
1. Ultraviolet light
2. Activators (catalysts)
3. Free radicals
4. Heat (high temperatures)

The simplest reaction takes place when the molecules of the vinyl compound are activated by ultraviolet light or heat. In this case, a few molecules among the large number of inactive molecules present in the reaction chamber are activated. The required heat of activation is approximately 23.5 Cal./mol:



Initiation reaction

To the activated molecule, 1000 or more molecules now add retaining the free radical state:



Propagation reaction

The end of this second reaction stage is determined by the occurrence of the termination reaction, which, according to Schulz, is caused by the reaction of two growing molecular chains.

For the activation reaction in the bulk polymerizaton of styrene with benzoyl peroxide as activator, Schulz[33] gives the following formula:

$$Bp + St \rightleftharpoons BpSt$$

One mol of benzoyl peroxide and 1 mol of styrene form an Arrhenius-type intermediate compound by absorption of energy; this compound rearranges monomolecularly either to an active intermediate compound

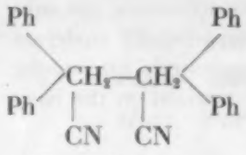
$$BpSt \longrightarrow BpSt^{+}$$

or it splits into activated styrene and peroxide.

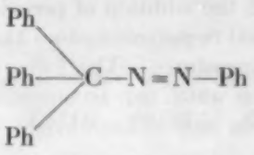
$$BpSt \longrightarrow Bp + St^{+}$$

There are also some examples in the literature of polymerization initiation reactions started through free radicals. The first such process published concerned the polymerization of butadiene, styrene and linseed oil with iron pentacarbonyl as polymerization acceler-

ator.[34] Schulz and Wittig used the radicals formed by thermal splitting of tetraphenylsuccinodinitrile[35] and triphenylmethylazobenzene as activators for the bulk polymerization of styrene.



Tetraphenylsuccinodinitrile



Triphenylmethylazobenzene

For this activation Schulz postulates the following:

$$R{-}R \longrightarrow 2(R{-})$$

$$R{-} + CH{=}CH_2 \longrightarrow R{-}\underset{\displaystyle Ph}{\underset{|}{CH}}{-}CH_2{-}$$

During the course of the propagation reaction further styrene molecules add themselves to the styrene molecule activated by the addition of the free radical.

This work concerning the activation of the polymerization reaction by means of free radicals is of great importance for further clarification of the reaction mechanism of polymerization. Oxygen, itself, in the nascent atomic state developed by decomposition of peroxides, is a free radical. Molecular oxygen can be considered a bi-radical.

$$O{=}O \longrightarrow {-}O{-}O{-}$$

This theory agrees with Logemann's opinion, set forth previously, that atomic oxygen acts as activator for the polymerization reaction.

In every polymerization there develops during the initiation reaction a relatively small amount of activated molecules to which, during the growth of the chain, the much more numerous monomeric molecules add while retaining the free radical state. The subsequent termination reaction starts when the decrease in monomeric molecules results in the reaction of two growing chains. But, surprisingly enough, according to the latest investigations by Schulz, the kind and amount of the added activators seem to have no influence on the termination reaction.

The chain length of the polymerization products (average polymerization degree) is determined by the following factors:

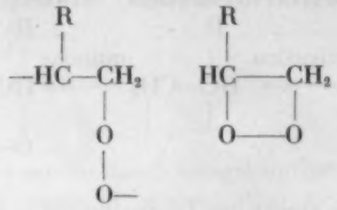
1. Polymerization temperature[37]
2. Amount of emulsifier (in emulsion polymerization)
3. Amount of activator (specially important, as previously mentioned)

Concerning the influence of the amount of activator on the average polymerization degree ($\bar{p}$), Schulz gives the following mathematical formula based on his exact measurements:

$$\bar{p} = \text{constant } \sqrt{c_{\text{Catalyst}}}$$

Staudinger explains the deactivating action of atmospheric oxygen as an addition of molecular oxygen to the free bonds of the molecule activated by the ultraviolet light. On the basis of our experiments the same deactivating action takes place with molecules activated by peroxides or atomic oxygen.

On the basis of the results of his experiments, Staudinger assumes that two different peroxides are formed:



Active Inactive

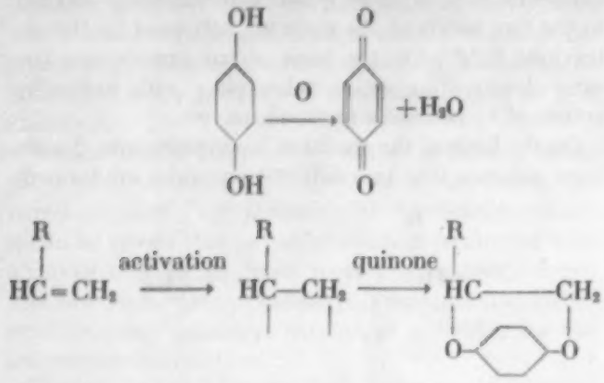
The active peroxide—the one which starts the polymerization—is supposedly formed at the higher temperature of the heat polymerization and the inactive one through the addition of oxygen to the molecule of the vinyl compound activated at low temperature in the presence of ultraviolet light. The inactive "moloxide" decomposes only at much higher temperatures (80° C. and more), so that the contradictory results arrived at by so many laboratories find a quite plausible explanation.

The decomposition of these *moloxides* formed under the influence of atmospheric oxygen is furthermore promoted by water or aqueous alkaline liquids. This explains the old interesting observation that the addition of water or aqueous alkalies will accelerate the polymerization reaction.[38] Naturally, the decomposition of the percompounds used as activators is also accelerated by water and aqueous solutions.[39]

On the basis of our present knowledge, one might well assume that the heat polymerization of butadiene, discovered by Hofmann[40] in 1909, will take place only at polymerization temperatures of 100° C. and more. Hofmann's *heat polymerization* was most probably also a catalytic polymerization process, occurring through decomposition of the moloxide formed from the diene and atmospheric oxygen. This interpretation is confirmed by our experiments concerning heat polymerization of isoprene at 80° C. in atmospheres of nitrogen and air, respectively, which showed that the polymerization is much faster in the presence of oxygen than in a nitrogen atmosphere.

Another example of the deactivating action of a compound, recently published, is the inhibiting action of hydroquinone on the polymerization of styrene.[41] According to the authors, the stabilizing action of hydroquinone is not observed in bulk polymerization of styrene when the experiment is made in an atmosphere of nitrogen. Only the quinone, formed in the presence of air, has an inhibiting influence on the polymerization reaction. It is very well possible that quinone, similarly to molecular oxygen, adds itself to the double bond of the styrene molecule activated by heat and that this styrene molecule, which is now inactivated, can

no longer function as a polymerization nucleus.



Whether this theory can be generalized as an explanation for the action of stabilizers and anti-aging compounds depends upon further investigations.

The reaction mechanism of the sodium/carbon dioxide polymerization of diolefins (dimethylbutadiene) developed by the BASF shortly before the first world war might possibly find an explanation in these new viewpoints. As is well known on the basis of the results of Harries' experiments to split ozonides, this process had to yield a *normal* synthetic rubber, in contrast to the polymerization products obtained with sodium alone as polymerization catalyst.

Oxygen in emulsion polymerization

The foregoing discussion has shown that the deactivating action of oxygen in polymerizations occurs by inactivation of the activated molecules of the monomer. The activation preceding this process is accomplished by ultraviolet light, heat or peroxide compounds. The percompounds form either double compounds (Arrhenius-type intermediate compounds, moloxides) which by subsequent decomposition activate the monomer or, what in my opinion is more probable, develop atomic oxygen by direct decomposition which then accomplishes the activation as a free radical.

In the special case of emulsion polymerization peroxides, such as hydrogen peroxide or potassium persulfate, are used as activators. Table II shows the different steps which led to present practice in emulsion polymerization. This table gives an interesting picture of the tedious way leading to the finally reached goal—emulsion polymerization.

This new polymerization method is applicable to a great number of vinyl compounds. The process is basically as follows: The monomers are emulsified in water with soap-type[9] emulsifiers and subsequently, with the addition of peroxides[10] as activators, are subjected to polymerization at definite, generally moderate temperatures. The following compounds are among those which can be emulsion polymerized on the basis of our present knowledge:

Vinyl compounds	Divinyl compounds
Vinyl chloride[11]	Butadiene[9]
Ethylene[44]	Isoprene[9]
Dichloroethylene[45]	Dimethylbutadiene[9]
Trichloroethylene[46]	Chlorobutadiene[53]
Vinyl esters[47]	Furylbutadiene[54]
Fumaric esters[48]	
Acrylic esters[11]	
Methacrylic esters[11]	
Vinyl ethers[49]	
Vinylketone[50]	
Styrene[51]	
Vinyl furane[52]	

The polymerization reaction is, according to the investigations of Schulz,[31] a reaction of the first order for which the following equation is applicable:

$$\frac{dx}{dt} = k(a - x)$$

The validity of this equation for emulsion polymerization was confirmed by Logemann.[28]

According to observations made during the last few years, the polymerization reaction does not start right away but only after some time, often only after several hours. This phenomenon, so far unexplained, is designated as the induction period. This period is the longer, the lower the polymerization temperature. But, according to our present investigations, the induction period is absent when atmospheric oxygen is excluded during polymerization. Thus, the delayed start of polymerization can be explained by the deactivating action of the molecular oxygen on the previously activated monomers.

Experiments concerning this were carried out with vinyl chloride, vinyl acetate, methyl acrylate, ethyl acrylate, butyl acrylate, (*Please turn to page 208*)

Table II.—The Development of Emulsion Polymerization of Butadiene

Polymerization method	*Activating agent*	*Patent*	*Patentee*
Bulk (heat)	.....	DRP 250,690 (Sept. 11, 1909)	Bayer Elberfeld (Hofmann and Coutelle)
Bulk	Water	EP 14,281/10 (June 13, 1910)	BASF
Bulk	Peroxide	EP 22,454/11 (Oct. 11, 1911)	BASF (Holt and Steimmig)
Bulk	Viscous liquids	DRP 254, 672 (Jan. 25, 1912) DRP 255,129 (Mar. 3, 1912)	Bayer Elberfeld (Gottlob)
Bulk (vinyl acetate)	Water + peroxide	DRP 431,146 (Aug. 14, 1924) DRP 490,040 (Nov. 8, 1924)	Cons. F. Elektr. Ind. (Baum & Hermann)
Emulsion	Soap-type emulsifiers	DRP 558,890 (Jan. 9, 1927)	I. G., Ludwigshafen (Luther and Heuck)
Emulsion	Oxygen or oxygen-yielding compounds	DRP 511,145 (Jan. 14, 1927)	I. G., Leverkusen (Tschunkur and Bock)

Ether esters, plasticizers for vinyl coating*

This study of plasticizers in which tests were made using two vinyl chloride-acetate copolymers and polyvinyl butyral indicated that certain fatty esters contributed desirable characteristics

by F. J. TUTTLE† and E. B. KESTER

THIS investigation was prompted by the need for new plasticizers, derivable from abundant and non-strategic materials, which would communicate properties desired in vinyl resins used in the manufacture of coated cloth for the Armed Forces. Requirements of such plasticizers are low water solubility, low volatility, low acid content and resistance to the chemical action of water. In addition, plasticizers should impart flexibility to the resins at low temperatures.

As fatty esters seemed to offer promise of possessing these attributes, it was decided to lay particular emphasis on synthesizing and testing this type of compound. The preparations described herein were largely confined to a group of ether esters of fatty acids, since the importance of this combination of functions had been clearly indicated in a previous investigation.[1] The plasticizers prepared were, for the most part, colorless or light yellow oils, boiling above 140° C. at 0.1–0.3 mm. Straight-chain saturated acids with 16 and 18 carbon atoms tended to yield crystalline products, and esters of shorter-chain acids such as tetrahydrofurfuryl laurate and glycidyl laurate were too volatile for practical purposes. The compounds described in this paper were prepared from long-chain unsaturated acids or mixtures, such as oleic acid and the saponified acids of vegetable oils, and also from sebacic acid. Acids were combined as esters of glycidol, tetrahydrofurfuryl alcohol, dimethyl glycerol ether, ethoxyethanol and butoxyethanol.

Direct esterification of the alcohols with the acids was conveniently used in most cases, except in the preparation of glycidyl esters which were made from commercial epichlorohydrin by reaction with anhydrous soaps.[2]

As an alternative method to direct esterification, a number of tests were made in which alcohols were reacted with vegetable oils, liberating glycerol. Although this process of transesterification resulted in yields of over 90 percent under the influence of alkali hydroxides at temperatures of about 50° C.; it was found to have serious disadvantages in that: 1) soaps, formed as a result of saponification by the alkali catalyst of a portion of the oils, were difficult to remove without entrainment of a considerable amount of product; 2) glycerol did not separate from the reaction mixture and had to be removed by washing;[3] 3) recovery of excess alcohol dissolved in the water-soap-glycerol layer was laborious; 4) unless carefully fractionated, the distilled products of transesterification contained significant amounts of triglycerides, which caused the esters to exhibit spewing when compounded as plasticizers in vinyl films. Because of these drawbacks, the practicality of transesterification for the immediate purpose is seriously questioned.

Preparation of the esters

The preparation of tetrahydrofurfuryl esters of corn oil will be described as illustrative of the various syntheses involving direct esterification. All other esters used in this investigation, except those of glycidol, were made by a similar procedure.

Tetrahydrofurfuryl alcohol (202.8 gm., 2.0 *M*) was placed in a round-bottomed flask with corn-oil acids (276.8 gm., 1.0 *M*), 100 ml. of benzene and 1 gm. of *p*-toluenesulfonic acid, and allowed to reflux under an azeotropic still head for 3 hours. At the end of this time, about 18 ml. of water had been removed, indicating that reaction was substantially complete. The acid content of the crude product was found to be 10.4 gm., calculated as oleic acid. Then 40 ml. of 1 percent sodium hydroxide was added with vigorous stirring, after which the liquid was thoroughly washed with water, dried and distilled at 151 to 192° C. and 0.1 mm. The distillate weighed 293.5 gm., representing a yield of 94.4 percent.

In most of the syntheses, 3 hr. were usually sufficient to esterify the major portion of the acids. In the case of the tetrahydrofurfuryl esters of tall oil, 10 percent of the original acids were still unreacted at the end of 32.5 hours. The presence of considerable amounts of difficultly esterifiable resin acids probably accounts for the extreme slowness of reaction.

Certain of the derivatives produced by direct esterification of the vegetable-oil acids had a pronounced and somewhat objectionable odor. It was found that

* Joint contribution from the laboratories of R. B. H. Dispersions, Bound Brook, N. J., and Western Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture, Albany, Calif.
† Present address, Kroma Chemical Co., Raritan, N. J.

[1] "New plasticizers for vinyl resins and cellulose esters," by Elam, Preusser and Page, MODERN PLASTICS *20*, 95 (May 1943).

[2] "Glycidyl esters of aliphatic acids," by Kester Gaiser and Lazar, J. Org. Chem. *8*, 550 (Nov. 1943)

[3] Exception noted in case of methanol.

Table I.—Properties of Plasticizers Investigated

Plasticizer	Boiling range		Specific gravity	Refractive index	Saponification value		Water solubility
	Temp.	Pressure			Found	Calcd.	
	° C.	mm.	d_{25}^{25}	n_D^{25}			g./1000 ml.
Tetrahydrofurfuryl oleate	175–85	0.3	0.9323	1.4640	364.2	366.57	0.02
Tetrahydrofurfuryl esters of castor oil acids	185–215	0.3	0.9595	1.4711	374.25	380.79	0.02
Tetrahydrofurfuryl esters of corn oil acids	151–92	0.1	0.9295	1.4665	356.5	359.9	0.015
Tetrahydrofurfuryl ester of tall oil	150–277	0.2	0.9611	1.4830	...	389.82	0.05
Tetrahydrofurfuryl esters of cotton seed oil acids	210–64	0.2	0.9269	1.4658	356.5	360.5	0.014
Glycidyl oleate	162–73	0.33	0.9258	1.4602	342.51	338.51	0.10
Glycidyl esters of castor oil acids	183–210	0.1	0.9706	1.4697	367.95	358.77	0.03
Ethoxyethyl sebacate	140–85	0.2	0.9987	1.4436	173.93	173.23	0.22
Butoxyethyl sebacate	180–215	0.1	0.9678	1.4451	200.87	201.28	0.06
Dimethyl glycerol ether oleate	168–98	0.3	0.9192	1.4527	376.86	384.58	0.02

if the oils were deodorized with steam or extracted with methanol prior to saponification, the resulting esters had little or no odor. Odorless tetrahydrofurfuryl esters of tall oil proved more difficult to obtain. A great improvement was observed, however, when the tall oil before esterification was dissolved in petroleum ether and extracted with 80 percent methanol. Because of the low price of tall oil, which is now a commercial by-product of the wood-pulp industry, its esters would be more economical from a materials cost standpoint to manufacture than any of those which is possible to derive from the various vegetable oils.

Plasticizing action on vinyl resins

In addition to the materials ultimately selected for study as compounding agents, a much larger number were initially prepared and tested for compatibility (which is, of course, the critical factor of greatest importance) and volatility. Types of vinyl plastics studied in this investigation were two chloride-acetate copolymers, Vinylite VYNW and Vinylite VYNS, containing about 95 and 90 percent of the chloride, respectively, and polyvinyl butyral.

The test consisted of dissolving 0.6 gm. of the compound in 37.5 ml. of methyl ethyl ketone containing 1.5 gm. of dissolved vinyl resin (0.04 gm./ml.) and allowing the mixture to evaporate at room temperature in 4-in. petri dishes. The deposited films were then removed and inspected for globules of oil, cloudy or opaque areas, flexibility and color. If retention of plasticizer by the resin was initially good, films were heated 2 hr. at 60° C. to remove the last traces of solvent, then weighed and suspended for 10 days in a mechanical-convection oven at 60° C. to determine loss of plasticizer by volatilization. Plasticizers which showed losses under 10 percent[4] were then investigated further with respect to water solubility and boiling-water stability.

During the course of the volatilization test, slight spewing occurred in some instances after about 5 days, even when freshly cast films had indicated complete compatibility. This behavior is characteristic, for example, of glycidyl oleate and tetrahydrofurfuryl oleate in Vinylite VYNS and VYNW. Some of the tests with polyvinyl butyral could not be completed with quantitative accuracy because of excessive sagging of the films at 60° C. and losses due to adhesion to the supports.

The properties of the plasticizers studied are shown in Table I. Their losses by volatilization according to the conditions of this test are summarized in Table II. The test is merely preliminary and is in no wise expected to agree with volatility tests on coated cloth run at more elevated temperatures for shorter periods of time and in presence of high percentages of pigments.

Figures for water solubility are maximum values. These determinations were made according to the method of Fordyce and Meyer.[5] All materials, when subjected to the action of boiling water for 24 hr., developed acidity corresponding to less than 0.15 percent hydrolysis. A number showed greater stability than this figure indicates, but because the method does not yield closely reproducible results, the individual analyses are not shown.

Tests on coated cloth

To determine the possible value of the various plasticizers in flexible fabric-coating formulations, samples were prepared by knife-coating cloth with solvent dopes containing resin, pigment and plasticizer.

[4] Dioctyl and dibutyl phthalate were volatilized to the extent of 9.5 and 52.9 percent, respectively, under these conditions.

[5] "Plasticizers for cellulose acetate and cellulose acetate butyrate," by C. R. Fordyce and L. W. A. Meyer, Ind. Eng. Chem. 32, 1053 (Aug. 1940).

Table II.—Loss of Plasticizer by Volatilization[a] from Vinyl Films

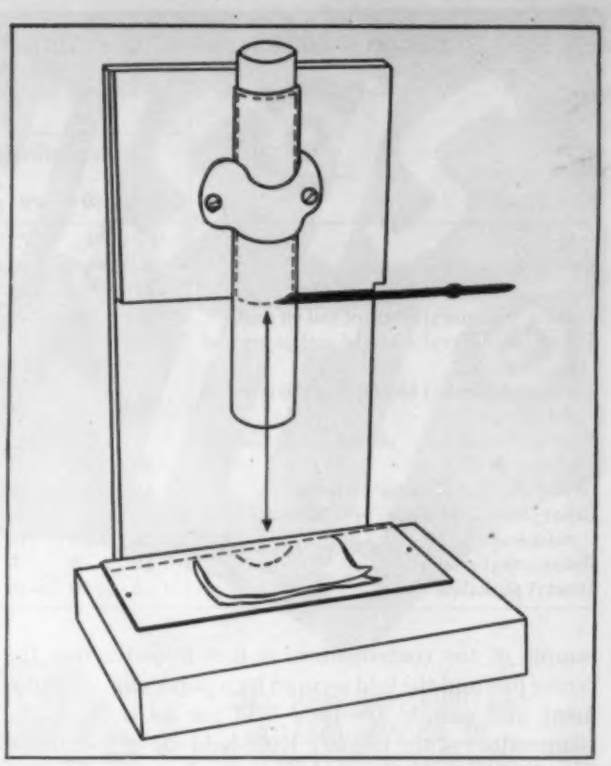
Plasticizer	—Plasticizer loss[b] from:—		
	Vinylite VYNW	Vinylite VYNS	Polyvinyl butyral
	%	%	%
Tetrahydrofurfuryl oleate	1.3	1.4	4.0
Tetrahydrofurfuryl esters of castor oil acids	7.2	7.5	...
Tetrahydrofurfuryl esters of corn oil acids	6.7	5.9	7.8
Tetrahydrofurfuryl esters of tall oil	2.3	3.0	2.5
Tetrahydrofurfuryl esters of cotton seed oil acids	5.5	4.3	...
Glycidyl oleate	7.6	4.3	7.6
Glycidyl esters of castor oil acids	6.0	1.2	...
Ethoxyethyl sebacate	3.9	4.5	8.1
Butoxyethyl sebacate	0.5	1.0	0.9
Dimethyl glycerol ether oleate	7.4	9.1	10.1

[a] Ten days at 60° C. in mechanical convection oven.
[b] Values are percent of plasticizer.

The fabric used throughout the tests was a 4.0 oz. per square yard sheeting having a thread count of 80 by 80. The coating was applied to the fabric until a dry pickup of 3.5 ± 0.5 oz. per square yard was attained. The coated cloth was calendered smooth in the conventional manner between applications. Finished samples were force-dried for 0.5 hr. at 250° F. and aged at room temperature for a minimum of 48 hr. before testing. Testing was limited to determining evaporation loss of the sample in an accelerated test and the influence on cold crack temperature of increasing concentrations of plasticizers and pigment loading. This method of testing was selected, after consideration of a number of procedures, because it yielded more closely reproducible results. The apparatus was a modification of one described by King.[6]

As an indication of the permanence of the plasticizer in the particular resin tested, coated-cloth samples were conditioned for 24 hr. at 70° C. and 65 percent relative humidity and weighed on an analytical balance. After 5 hr. at 105° C. in a circulating-air oven, the sample was again conditioned and reweighed. The loss in weight expressed as percent of total coating indicated relative permanency of the plasticizer. A loss of 5 percent or less is considered satisfactory for most applications. These data for the three vinyl types studied are presented in Table III, together with cold-crack temperatures at optimum plasticizer levels.

The cold-crack point was determined with equipment, pictured in Fig. 1, which consists of a 425-gm. cylindrical brass rod ($^{31}/_{32}$ in. in diameter and 4 in. high), mounted on a wooden stand by means of a vertical sleeve through which it moves freely. Impact of the rod is against a $^{1}/_{16}$-in. thick steel plate coated with black nitrocellulose lacquer. A guide line is drawn opposite the median line of the weight. A 3 by 3 in.



1—Equipment for determining cold-crack point consists of brass rod mounted on stand by means of vertical sleeve

[6] "Bend-brittle and shatter points of rubber-like materials," by Glen E. King, Ind. Eng. Chem. 35, 949 (Sept. 1943).

Table III.—Volatility and Cold-Crack Behavior of Plasticizers in Vinyl Coatings

Plasticizer	*Polyvinyl butyral coating*			*Vinylite VYNS coating*			*Vinylite VYNW coating*		
	Plasticizer per 100 resin and 100 pigment	*Cold-crack point*	*Volatilization loss*[c]	*Plasticizer per 100 resin and 100 pigment*	*Cold-crack point*	*Volatilization loss*[c]	*Plasticizer per 100 resin and 100 pigment*	*Cold-crack point*	*Volatilization loss*[c]
	parts	*° F.*	*%*	*parts*	*° F.*	*%*	*parts*	*° F.*	*%*
Tetrahydrofurfuryl oleate[a]	80	−65	1.63	80	−30	4.35	100	−50	4.86
Tetrahydrofurfuryl esters of castor oil acids	90	0	0.53	80	−20	1.19	100	0	2.82
Tetrahydrofurfuryl esters of corn oil acids	80	−20	0.26	80	−40	2.50	100	−20	3.0
Tetrahydrofurfuryl esters of tall oil acids	90	−30	0.81	90	−50	1.26	100	−10	1.84
Tetrahydrofurfuryl esters of cotton seed oil acids	...	...	...	...	...	...	90	0	1.40
Glycidyl oleate[a]	100	−65	1.97	80	−20	6.50	100	−40	5.59
Glycidyl esters of castor oil acids	80	−10	0	100	−50	0.36	90	−10	0.69
Ethoxyethyl sebacate	80	−40	2.55	80	−40	4.27	80	−40	6.11
Ethoxyethyl sebacate and methoxyethyl ricinoleate (2:1)	...	...	...	100	−40	2.52	...	...	...
Butoxyethyl sebacate	60	−40	1.5	90	−30	0.93	90	−30	1.0
Dimethylglycerol ether oleate[b]	80	−20	3.60	80	−40	5.35	100	−40	8.37

[a] Slight spew in Vinylite VYNS and VYNW.
[b] Slight spew in polyvinyl butyral and Vinylite VYNS.
[c] Values are percent of total coating.

Table IV.—Effect of Increase in Plasticizer on Cold-Crack Temperature of Vinyl Coatings

Plasticizer	*Cold-crack temperature of Vinylite VYNS coating*							*Cold-crack temperature of Vinylite VYNW coating*					
	Parts plasticizer per 100 resin and 100 pigment							*Parts plasticizer per 100 resin and 100 pigment*					
	50	*60*	*70*	*80*	*90*	*100*	*110*	*50*	*60*	*70*	*80*	*90*	*100*
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Tetrahydrofurfuryl oleate	−30	−30	−40	−40	−50	−50	...	−20	−20	−30	−30	−30	−40
Tetrahydrofurfuryl esters of corn oil acids	−10	−20	−30	−40	−40	−40	...	20	10	−10	−10	−10	−20
Tetrahydrofurfuryl esters of tall oil acids	−30	−40	−40	−40	−50	−50	...	10	10	10	10	0	−10
Tetrahydrofurfuryl esters of cotton seed oil acids	...	...	...	...	...	...	...	20	20	10	10	0	0
Tetrahydrofurfuryl oleate + methoxyethyl ricinoleate (2:1)	−30	−30	−40	−40	−50	−50	−50	...	...	...	...	...	...
Tetrahydrofurfuryl oleate + dioctyl phthalate (2:1)	−40	−40	−40	−40	−50	−50	−50	...	...	...	...	...	...
Glycidyl esters of castor oil acids	10	0	−10	−20	−40	−50	...	...	...	...	...	...	...
Ethoxyethyl sebacate + methoxyethyl ricinoleate (2:1)	10	0	−10	−20	−30	−40	−40	...	...	...	...	...	...
Butoxyethyl sebacate	10	0	0	−20	−30	−30	...	0	−10	−10	−20	−30	−30
Dioctyl phthalate	0	−10	−10	−20	−30	−30	...	0	−10	−20	−30	−30	−30

sample of the coated fabric is first folded across the center line and the fold secured by a paper clip. Equipment and sample are then held for an hour at the temperature of the test in a Kold-hold sub-zero cabinet. The folded sample is moved up to the guide line and the rod is allowed to drop on the fold from a height of 5 in. by a release device. Cracking was detected by inspection; in case of doubt a low-power magnifying glass was used. Tests were run at intervals of 10° F. and the temperature, reported as a cold-crack point, is the lowest temperature at which the sample passed the test.

Table IV indicates the effect of increasing plasticizer on cold crack of Vinylite VYNS and VYNW. It will be noted that in most cases optimum resistance to crack occurs at plasticizer levels between 80 and 90 parts per 100 of resin. However, as films with this plasticizer content are tacky, it would be necessary to sacrifice some cold-crack resistance to obtain block resistance. The advantage in the use of mixtures of plasticizers has been well recognized. For example, a relatively volatile plasticizer with excellent cold properties may be blended with a non-volatile material, often with little sacrifice in cold resistance. (Note the effect of replacing one-third of ethoxyethyl sebacate with methoxyethyl ricinoleate.) Again, the addition of a strong-solvent type of plasticizer will often inhibit the spew of a less compatible type (dioctyl phthalate with tetrahydrofurfuryl oleate). It is significant that the tetrahydrofurfuryl esters of tall oil and corn oil acids produce a more pronounced lowering of the crack point in the case of Vinylite VYNS than of VYNW at a given concentration. Tetrahydrofurfuryl esters also depressed the cold-crack point at lower percentages than either ethoxyethyl or butoxyethyl sebacate and showed less disposition to be affected at low temperatures by loading with pigments.

Table V shows the effect of pigment loading on a typical formulation of VYNS. Inspection of the data reveals that the rate of rise in cold-crack temperature with increase in pigment loading may vary considerably with the plasticizer used.

Summary

Results of this study on plasticizers and their application to vinyl resins for coated cloth indicate that certain fatty esters contribute highly desirable characteristics, particularly low volatility and resistance to crack at low temperatures. These materials have been tested in two vinyl chloride-acetate copolymers, Vinylite VYNS and VYNW, and in polyvinyl butyral. A cold-crack point of −40° F. or below was obtained for one or more of these types with eight of the compounds that were studied in these tests. The superiority in this respect to dioctyl phthalate was clearly indicated in most instances.

Table V.—Effect of Pigment Loading on Cold-Crack Temperature of Vinyl Coating

Plasticizer combination and ratio	*Cold-crack temperature of Vinylite VYNS coating*						
	Parts pigment per 100 resin and 80 plasticizer						
	50	*75*	*100*	*125*	*150*	*175*	*200*
	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Ethoxyethyl sebacate and methoxyethyl ricinoleate (2:1)	−40	−30	−20	−10	0	0	20
Tetrahydrofurfuryl oleate and methoxyethyl ricinoleate (2:1)	−50	−40	−40	−40	−30	−20	0
Tetrahydrofurfuryl oleate and dioctyl phthalate (2:1)	−50	−50	−40	−40	−40	−10	0

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General

SILICONE RUBBER GASKETING MATERIALS FOR HIGH TEMPERATURE USES. J. A. Moffitt and A. Panagrossi. Machine Design *18*, 109–13 (Sept. 1946). The physical, electrical and chemical resistance properties of three coating and laminating and five molding and extruding silicone gasket materials are reported. Several gasket applications are described. Glass fabric is used in the laminated type of gaskets. These silicone resins vary in density from 1.3 to 2.3, in Shore hardness from A40 to A85, in tensile strength from 400 to 700 p.s.i., in elongation from 50 to 300 percent, in water absorption from 0.5 to 2.8 percent, in dielectric constant from 3.0 to 9.8 and in dielectric strength from 500 to 1100 volts per mil. Their chemical resistance is good and depends on the type. None of the types described are resistant to toluene, gasoline, Stoddard solvent and carbon tetrachloride.

PROPERTIES OF ETHYL SILICATE. H. D. Cogan and C. A. Setterstrom. Chem. Eng. News *24*, 2499–2501 (Sept. 25, 1946). The commercial importance of ethyl silicate for the deposition of silica is steadily increasing. As more is learned about methods of stabilizing polymers and as research with techniques of handling continues, it is likely that ethyl silicate and its products of hydrolysis and polymerization will become of fundamental importance in many more industrial applications.

Materials

STYRENE-DIENE RESINS IN RUBBER COMPOUNDING. A. M. Borders, R. D. Juve and L. D. Hess. Ind. Eng. Chem. *38*, 955–8 (Sept. 1946). Pliolite S-3, a copolymer of approximately 15 parts butadiene and 85 parts styrene, is a thermoplastic resin with excellent oxygen and chemical resistance. It is compatible with natural rubber and with most synthetic rubbers. In mixtures with rubbers as a reinforcing resin, it is valuable for improvement of smoothness during extrusion or calendering and for reduction of shrinkage. Although Pliolite S-3 alone is brittle at room temperatures, in mixtures with rubber (up to 50–50), it does not increase the rate at which the mixture stiffens with reduction in temperature. Data are tabulated which illustrate the effect of the copolymer in GR-S or natural rubber compounds upon hardness, stiffness, extrudability, tensile strength and impact resistance. The low moisture absorption and excellent electrical properties have encouraged the use of the copolymer in rubber compounds for electrical insulation.

PROPERTIES OF LACTOPRENE EV. T. J. Dietz, W. C. Mast, R. L. Dean and C. H. Fisher. Ind. Eng. Chem. *38*, 960–7 (Sept. 1946). Milling characteristics and physical properties of Lactoprene EV, a vulcanizable copolymer of 95 percent ethyl acrylate and 5 percent chloroethyl vinyl ether, were investigated. The polymer does not require preliminary breakdown on the mill and, when properly formulated, the stock may be compounded without difficulty. Tensile properties of Lactoprene vulcanizates are well above a serviceable minimum, but the cured product exhibits low resilience on the formulations studied. In the field of specialty rubbers, the product possesses two outstanding properties—resistance to oils and to dry heat. In its resistance to organic solvents, Lactoprene EV compares favorably with butadiene–acrylonitrile copolymers. The heat resistance of the vulcanized polymer is markedly superior to the heat resistance of any of the present diene synthetics.

Applications

CARAVAN LUXURY BY USE OF PLASTICS. Plastics (London) *10*, 481–4 (Sept. 1946). Various applications of plastics in the construction of a motor car trailer are described. These include plastic insulation material, expanded synthetic rubber walls, and roof and side windows of methyl methacrylate plastic. Many of the interior parts are made of methacrylate plastic.

THERMOPLASTIC LABELER FOR BOTTLED PRODUCTS. Modern Packaging *20*, 128–9, 170, 172 (Sept. 1946). A machine for applying labels to bottles with thermoplastic adhesives is described. The labels are heat-sealed onto the bottle. Various problems concerned with this new type of labeling are discussed in detail in this article.

VINIDUR PIPELINES AND THEIR INSTALLATION. A. Henning. Plastics (London) *10*, 418–29 (Aug. 1946). This is an abridged translation of an article by G. Haim and H. P. Zade from Kunststoffe *34*, 161–8 (1944). The properties and fabrication technique for pipes made of polyvinyl chloride plastics are described. These pipes have excellent resistance to chemical attack and have good mechanical properties. They are easily cut, bent and welded. They are particularly suitable for use in the chemical and food industries.

DUFAYLITE. British Plastics *18*, 327–9 (July 1946). Plastics (London) *10*, 351–3 (July 1946). A honeycomb-like low density material made of paper and resin is described. It is made in three grades or densities for strong, light-weight panels and for thermal insulation.

Coatings

LABORATORY DETERMINATION OF DRYING. A. E. Bartlett. Organic Finishing *7*, 14–21, 62 (Apr. 1946). Various laboratory devices and techniques for determining the drying time of coatings are critically analyzed. A new improved device which can be employed for this purpose is described.

GEL LACQUER TECHNIQUE FOR PROTECTIVE COATING. C. J. Malm and H. L. Smith, Jr. Ind. Eng. Chem. *38*, 937–41 (Sept. 1946). The gel lacquer technique is designed for the application of unusually heavy coatings. This process depends upon the ability of the lacquer to undergo gelation by temperature change alone, without the necessity of solvent evaporation. This behavior is obtained by proper selection and balance of the solvents. Film formers chosen from the group of cellulose mixed esters are suitable for the base of these lacquers, and produce coatings of plastic appearance and properties. The lacquer is applied by dipping in a viscous solution maintained at approximately 120° F. On cooling to room temperature, the heavy coating immediately sets to a firm gel which will not sag or wrinkle. Because of this property of gelation, it is feasible to apply films as thick as 0.015 in. per dip over a variety of core materials.

PROTECTIVE ORGANIC COATINGS. J. J. Mattiello. Chem. Ind. *59*, 277, 398 (Aug. 1946). Developments in protective coatings during the last two years are discussed.

OIL MODIFICATION OF ALKYD RESINS FOR PROTECTIVE COATINGS. C. G. Moore. Oil & Soap *23*, 69–70 (1946). The synthesis and properties of oil-modified alkyd resins are discussed. The properties imparted by the alcohols, acids, anhydrides and oils used in the resins are described.

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Technical Briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

ADHESIVES FOR RUBBER. J. A. Merrill. Rubber Age *59*, 313–16 (June 1946). Adhesives for rubber are discussed. At the present time the following methods are used for obtaining adhesion to rubber: 1) brass plating of metals, 2) rubber and synthetic rubber derivative cements, 3) synthetic resin cements, 4) synthetic rubber base adhesives and 5) miscellaneous chemical compounds. The second group comprises natural rubber isomers formed by treating rubber with phenol sulfonic acid or tin tetrachloride and the chlorine and hydrogen chloride addition products of rubber. The third group comprises the phenol-aldehyde resins. The fifth group comprises the polyisocyanates.

"METALITE" FOR STRUCTURAL USES. Aero Digest *53*, 82, 115 (Aug. 1946). A sandwich material made by cementing thin sheets of aluminum alloy to a core of end-grain balsa wood is described herein.

SIGNIFICANCE OF IMPACT TEST DATA IN DESIGN OF ENGINEERING STRUCTURES. D. F. Windenburg. Product Eng. *17*, 81–3 (Sept. 1946). Examination of Charpy specimens after test reveals that specimens that absorb high values of energy exhibited a considerable amount of ductility, whereas those tested below the transition temperature at which little energy was absorbed showed no signs of ductility. It is therefore recommended that the acceptance specifications for materials to be used under tensile loading, especially at low temperatures, require impact or other suitable tests to insure adequate ductility at the structure's working temperature.

A STUDY OF RESINOUS SEALANTS FOR POROUS METAL CASTINGS. V. C. F. Holm. J. Research Nat. Bur. Standards *37*, 177–82 (Sept. 1946). Nine thermosetting polyester resins, four phenolic resins and a resorcinol-formaldehyde resin were tested to determine their efficiency as sealants for porous castings. Only two of these, a styrene-polyester resin and a phenolic resin, showed promise in this respect. Even these two resins sealed only 50 percent of the specimens subjected to one treatment, but a second impregnation increased the sealing efficiency to about 80 percent. As a double treatment does not insure complete sealing, it is necessary to test all castings to identify those which have not been sealed. This undesirable feature necessarily limits the value of the process and for that reason the use of sealants, except in some special applications, probably will be resorted to only in emergencies. Regardless of the circumstances requiring the use of a given sealant, its durability under service conditions should be given first consideration. The results of the tests indicated that a resin may be decidedly superior for one type of exposure but may be of questionable value under other service conditions. Thus, the styrene-polyester resin was considerably more satisfactory than the phenolic resin in exposure to petroleum products, while the phenolic resin was superior for elevated temperature conditions. In addition, the phenolic resin required the application of higher pressures to produce failure at room temperatures. Both resins were reasonably stable in exposure to boiling water. Under thermal shock conditions the polyester resin was decidedly superior. Undoubtedly this is due to the fact that the latter forms a resilient material upon curing whereas the phenol-formaldehyde resin is converted into a glassy, brittle mass that fractures readily as the casting expands and contracts.

Chemistry

β-AMINOETHOXYL and β-CYANOETHOXYCELLULOSE ACETATES. T. S. Gardner. J. Polymer Sci. *1*, 289–92 (Aug. 1946). Mixed cellulose acetate-ethers were prepared which contain basic-type nitrogen groups of these derivatives. Films were dyed by xylene brilliant blue. β-Aminoethoxylcellulose acetate was prepared from cellulose diacetate and yarn-type cellulose acetate-propionate using ethyleneimine. β-Cyanoethoxylcellulose acetate was prepared from β cyanoethoxylcellulose and from cellulose acetate using acrylonitrile with an organic base as catalyst. The solubilities of the mixed ether-esters containing basic type nitrogen groups were less than those of cellulose esters and ethers of comparable degrees of substitution.

COPOLYMERIZATION OF ALLYL ACETATE WITH MALEIC ANHYDRIDE. P. D. Bartlett and K. Nozaki. J. Am. Chem. Soc. *68*, 1495–1504 (Aug. 1946). Maleic anhydride is polymerized at 55° C. by benzoyl peroxide, about 29 monomer molecules being polymerized for each peroxide molecule decomposed. Allyl acetate and maleic anhydride undergo rapid and highly selective copolymerization in the presence of benzoyl peroxide. The copolymerization is more rapid at 30° C. than the polymerization of either of the monomers separately at 80° C. The peroxide decomposition under these conditions is largely induced by chain transfer, being 196 times as rapid as in allyl acetate alone. For each peroxide molecule decomposed, 187–427 molecules of monomer are polymerized, compared with not over 36 for allyl acetate separately under the same conditions, and a similar figure for maleic anhydride. The copolymer is insoluble in the mixture of monomers and shows only limited solubility in all solvents except water.

STRUCTURE OF UREA-FORMALDEHYDE RESINS. C. S. Marvel, J. R. Elliott, F. E. Boettner and H. Yuska. J. Am. Chem. Soc. *68*, 1681–6 (Sept. 1946). A mechanism for the polymerization of urea-formaldehyde resins, based on the view that urea is an amino acid amide is suggested. The polymerization is postulated as proceeding in two stages: first, the formation of trimethylenetriamine rings from methylene urea or the monomeric methylene methylol urea and then the formation of methylene-bisamide links to tie the rings together to form a cross-linked molecule. As support for this theory, resins were prepared from the reaction of glycinamide and aminocaproamide with formaldehyde. The composition of these resins indicates that they are composed of trimethylenetriamine rings linked by methylene bridges between amide groups on different rings. The trimers of the methylene-imine derivative of glycine methylamide and urethan were prepared. Sarcosinamide appears to react with formaldehyde to produce a low molecular weight linear polymer.

Properties

PACKAGING INSTITUTE STANDARD TEST METHOD FOR WATER-VAPOR PERMEABILITY AT 0° F. Modern Packaging *19*, 140–2, 172, 174 (July 1946). A test method for determining the water-vapor permeability of packaging materials at 0° F. is described.

PACKAGING INSTITUTE STANDARD TEST METHOD FOR HEAT-SEALING STRENGTH. Modern Packaging *20*, 150–1, 180, 182 (Sept. 1945):

Unbreakable Plexiglas and Lucite mirrors for cosmetic items
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A test procedure for measuring the ability of thermoplastics and thermoplastic-coated materials to form a seal is given. The materials are sealed under specified conditions and the force required to peel them apart is determined with a pendulum-type tensile testing machine.

COMPOSITION OF CELLULOSE ESTERS. C. R. Fordyce, L. B. Genung and M. A. Pile. Ind. Eng. Chem., Anal. Ed. *18*, 547–50 (Sept. 1946). The composition of cellulose esters in terms of the number of ester groups per anhydro-glucose may be determined readily from analytical data by calculations or by reading from nomographs. Equations and nomographs are given for cellulose acetates, propionates, butyrates, acetate propionates and acetate butyrates. By either method the percent acetyl, propionyl or butyryl in any of these cellulose esters can be easily converted to the number of acetyl, propionyl, or butyryl and hydroxyl groups per anhydroglucose unit or exactly vice versa.

RELATION BETWEEN SPECIFIC REFRACTIVITY OF POLYMERS AND ATOMIC STRUCTURE OF POLYMER UNIT. R. H. Wiley. Ind. Eng. Chem. *38*, 959–60 (Sept. 1946). The refractive index and density data for twenty-six polymers were used to determine unit refractivities, defined as the specific refractivity multiplied by the summation of the atomic weights of the atoms in the polymer unit. These unit refractivities agree with values calculated as a summation of the atomic refractivities of the atoms in the units of the polymer chain. New data are reported for polyvinyl chloroacetate and for the copolymer of styrene and maleic anhydride.

SIZE AND SHAPE OF MACROMOLECULES IN SOLUTION. P. M. Doty and H. Mark. Ind. Eng. Chem. *38*, 682–6 (July 1946). Polymer molecules are chain- or thread-like structures of very small cross-sectional area. Although the coiled molecule may extend over distances of several thousand Angström units, the determination of its size, shape and weight is not susceptible to most of the direct method used for particle size determination of more compact particles. Indirect methods of determining the size of polymer molecules are reviewed. Methods based on the ultracentrifuge, on osmotic pressure, on light scattering and on streaming birefringence are discussed. Forty-one references.

INFLUENCE OF HOT STRAINING. Z. Rogowsky. British Plastics *18*, 348–51 (Aug. 1946). The effect of hot forming on the mechanical properties of methyl methacrylate plastic was investigated. The impact strength of methyl methacrylate plastic rises with increasing strains resulting from hot pressing to values far in excess of those of its unstrained state. At the same time the strength does not diminish rapidly in the direction perpendicular to the direction in which hot strain was created. The bending strength also increases, as does, to a much greater extent, the ultimate bending angle. No conclusion may be drawn regarding notch sensitivity.

WATER-VAPOR PROTECTION BY CERTAIN NON-METAL PACKAGES. R. E. Thomas, R. F. Brooks and G. J. Hucker. Modern Packaging *19*, 143, 174, 176 (July 1946). The effectiveness of various packaging materials in protecting dehydrated beets and carrots was determined by storage tests at 90° F. and 90 percent relative humidity, at 120° F. and 50 percent relative humidity and at 90–111° F. and 72–75 percent relative humidity, respectively. Moisture content of the dehydrated vegetables was determined after storage at 33, 96 and 182 days. None of the non-metal packages studied were as effective as metal in protecting bulk packaged beets from water vapor when stored for a period of 6 months at 90° F. and 90 percent relative humidity, and at 120° F. and 50 percent relative humidity. Dehydrated vegetables stored in non-metal bulk packages increased at least 10 percent in moisture content over a period of six months when stored at high temperature and high humidity and in most cases the increase was from 25 to 100 percent.

DIPOLE MOMENTS OF LINEAR AND CYCLIC POLYMETHYLPOLYSILOXANES. R. O. Sauer and D. J. Mead. J. Am. Chem. Soc. *68*, 1794–7 (Sept. 1946). Dielectric constants at 20° C. and 60 cycles are reported for a series of liquid linear and cyclic polymethylpolysiloxanes.

QUANTITATIVE DETERMINATION OF SOME INHIBITORS IN POLYMERS BY ULTRAVIOLET LIGHT ABSORPTION. F. W. Banes and L. T. Eby. Ind. Eng. Chem., Anal. Ed. *18*, 535–8 (Sept. 1946). A spectrophotometric method of analysis for inhibitors in polymers was developed. This method corrects for background absorption and was found to be rapid and more reliable than chemical methods of analyses which were investigated. Results obtained with several synthetic rubber polymers are reported.

Testing

STUDY OF THE "H" TEST FOR EVALUATING THE ADHESIVE PROPERTIES OF TIRE CORD IN NATURAL AND GR-S RUBBERS. India Rubber World *114*, 213–17, 219 (May 1946). This article is a full abstract of United States Department of Agriculture, Bureau of Agriculture and Industrial Chemistry, Publication AIC-99 by W. J. Lyons, M. L. Nelson and C. M. Conrad, dated October 1945. A process for evaluating adhesion of rubber to tire cord is described. The results of an investigation made to determine effect of various factors on adhesion are reported.

Synthetic rubber

COMPOSITION OF BUTADIENE-STYRENE COPOLYMERS PREPARED BY EMULSION POLYMERIZATION. E. J. Meehan. J. Polymer Sci. *1*, 318–28 (Aug. 1946). Experimental data are presented on the monomer composition of copolymers of butadiene and styrene prepared by emulsion polymerization at 50° C. The composition of the copolymers is shown to be unaffected by variations in the amount of emulsifier, of mercaptan and of the nature of the water-soluble polymerization catalyst. The composition of the copolymers formed from a charge containing 25 percent styrene (by weight) can be represented accurately over the entire conversion range by the approximate theory according to which each monomer disappears by a first order reaction with the growing chain of the polymer, without taking into account the fact that the end of the growing chain to which the monomer adds may be a radical derived from either of the two monomer molecules. If the ratio of monomers in the charge is varied within wide limits, however, it is found that the simple theory is not adequate and it is necessary to consider that the chain may end with different radicals. The analysis of the experimental data shows that a butadiene molecule adds more rapidly than a styrene molecule to a radical derived either from a butadiene or a styrene molecule.

USE OF DUREZ 12687 POWDERED RESIN WITH SYNTHETIC RUBBERS. J. W. Ferguson. India Rubber World *114*, 218–19 (May 1946). A thermosetting phenol-formaldehyde is compounded with butadiene-acrylonitrile, butadiene-styrene and neoprene rubbers to produce hard, inflexible, heat-resistant, oil-resistant and solvent-resistant products. It is most useful with the butadiene-acrylonitrile rubbers and of limited use with the other two types. Compounding details and physical properties of the products are reported.

NEW METHOD FOR DETERMINING THE FILLER CONTENT OF VULCANIZED RUBBER. R. A. Hublin. Rubber Chem. & Tech. *19*, 482–5 (Apr. 1946). The new reagent, *o*-nitroanisol, makes it possible to shorten to a considerable extent the determination of the total filler content of vulcanized rubber by a solution method and to increase the precision of the determination. The procedure is carried out more easily than are the older classic procedures. This method is more accurate than calcination methods and more convenient than the conventional solution methods.

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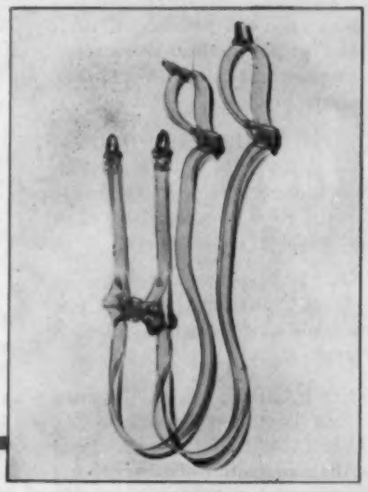

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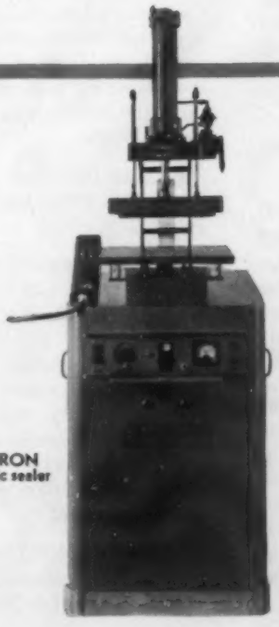

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U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

ORNAMENTATION. E. Karfiol and W. A. Roehm (to Royal Lace Paper Works). U. S. 2,404,073, July 16. A method for embossing and printing decorations on organic plastic surfaces.

DECORATIVE ARTICLE. M. A. Knauff. U. S. 2,404,136, July 16. A three-dimensional picture comprising a sheet of plastic material in which component parts of the subject scene are embedded at different levels.

ELECTRODE. J. C. Quayle and P. Jones (to British Insulated Cables Ltd.). U. S. 2,404,191, July 16. An apparatus for simultaneously subjecting thermoplastic or thermosetting resins to pressure and high-frequency heating.

COPOLYMERS. G. F. D'Alelio (to General Electric Co.). U. S. 2,404,220, July 16. A process comprising polymerizing a solution of divinyl benzene in a dialkyl benzene in the presence of vinyl acetate and a polymerization catalyst, and isolating the heat-convertible, fusible, partial polymer.

RESINS. C. E. Barnes (to Polaroid Corp.). U. S. 2,404,267–8, July 16. Copolymers containing polymerized alpha (*o*-chlorophenyl) ethyl methacrylate or a cyclohexycyclohexyl methacrylate.

RESINS. M. Hyman, Jr. (to Polaroid Corp.). U. S. 2,404,292, July 16. Copolymers containing *p*-methoxy benzyl methacrylate.

COATED FABRIC. E. A. Rodman (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,313, July 16. A coated fabric for the manufacture of raincoats and the like comprising a lightweight textile fabric coated with a composition containing a vinyl chloride-acetate copolymer, the azelnic diester of the monobutyl ether of ethylene glycol, pigments and a stabilizer of the resin.

COATING. H. K. Ash (to Interchemical Corp.). U. S. 2,404,353, July 23. A lacquer, which will deposit a permanently strippable film on cellulose acetate, comprising ethyl cellulose, a plasticizer and an alcohol or hydrocarbon solvent.

COATING. M. F. Bechtold (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,357, July 23. Methyl methacrylate polymer is given improved surface characteristics by the application of a coating solution containing ethyl silicate hydrolyzed with at least 15 percent of water and a partially hydrolyzed vinyl acetate polymer, said coating being heated under pressure so as to cure it.

PLASTICIZING. F. M. Roddy. U. S. 2,404,406, July 23. A continuous process for plasticizing discrete dry particles of a thermoplastic material comprising circulating a stream of the material in a highly heated, semi-molten state through a restricted passageway at a velocity sufficient to produce turbulent flow, continuously adding heat, withdrawing a minor portion at one point and feeding in fresh, dry, solid material at a point remote from that of the withdrawal.

CHLORINATED RESIN. H. N. Stephens, G. B. Gehrenbeck and D. R. Guthrie (to Minnesota Mining and Manufacturing Co.). U. S. 2,404,411, July 23. An acetone-soluble resinous glyceride of a chlorinated maleic anhydride-China wood oil adduct, said resinous material being non-liquefiable on heating.

TRANSPARENT PLASTIC. B. Andersen (to Celanese Corp. of America). U. S. 2,404,422, July 23. A transparent container for moisture yielding materials comprising an ester of cellulose, the inner surface of which is saponified so that it is capable of absorbing moisture without fogging or sweating.

SURFACE TREATMENT. M. F. Bechtold and P. S. Pinkney (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,426, July 23. A solid organic polymer is given improved surface characteristics by coating with a solution comprising an acid polysilicic acid ester of an alcohol, a polymer containing hydroxyl groups and a volatile organic solvent, said coating being cured at elevated temperatures.

COATING. R. Canter and H. D. Geyer (to General Motors Corp.). U. S. 2,404,431, July 23. A freezing device, portions of which are coated with a water-repellent composition comprising a urea-formaldehyde resin, an alkyd resin and a high melting wax.

DISPERSIONS. G. O. Morrison and H. M. Collins (to Shawinigan Chemicals, Ltd.). U. S. 2,404,519, July 23. A coating composition is prepared by adding a wax to an aqueous dispersion of polyvinyl acetate which is heated to a temperature above the melting point of the wax and by then cooling the aforementioned dispersion slowly by means of stirring.

MOLDING. B. D. Ashbaugh (to Hydraulic Development Corp., Inc.). U. S. 2,404,559, July 23. A machine for molding plastic materials.

COMBUSTIBLE PLASTIC. H. A. Bruson and G. B. Butler (to Rohm and Haas Co.). U. S. 2,404,688, July 23. A readily combustible plastic comprising the polymer of a nitrohydrocarbon ester of an unsaturated acid such as maleic acid.

INSECT REPELLENT COMPOSITION. A. Dreyling (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,698, July 23. A composition of gel-like consistency comprising a plurality of cellulose derivatives such as cellulose esters and ethers, and an insect-repellent substance.

POLYMERS. U. Hoffmann and H. Meis (to Alien Property Custodian). U. S. 2,404,711, July 23. Polymers are formed by causing polymerization catalysts such as bleaching earths and acid reacting substances to react upon aromatic compounds nuclearly substituted with vinyl groups in the absence of water and in the presence of ketones having the carbonyl group conjugated with a carbon to carbon double bond in the presence of an oxygen-containing compound such as a phenol or a phenolalkyl ether.

POLYMER. R. C. Houtz, G. H. Latham, A. O. Rogers, V. L. Hansley, R. E. Merner, W. H. Charch and T. G. Finzel (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,713–28, incl., July 23. Clear and substantially colorless solutions of polyacrylonitrile are prepared by mixing in finely divided form with a liquid which is a solvent for said resin at high temperatures and heating said mixture until solution is effected.

FLASHLIGHT. J. G. Lippincott (to Guth, Stern & Co., Inc.). U. S. 2,404,735, July 23. A plastic casing for a flashlight.

A UREA-FORMALDEHYDE RESIN. J. A. Murray and G. H. Metzger (to Libbey-Owens-Ford Glass Co.). U. S. 2,404,740, July 23. The viscosity of a butyl alcohol solution of a urea-formaldehyde resin is increased without decreasing its compatibility with hydrocarbons by maintaining the ratio of resin to butyl alcohol sufficiently high while in an acid and anhydrous condition until the desired viscosity is attained.

VINYL COPOLYMERS. H. W. Arnold, M. M. Brubaker and G. L. Dorough (to E. I. du Pont de Nemours & Co., Inc.),

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U. S. 2,404,779-80-81, July 30. A polymerization process comprising emulsifying a vinyl halide with an alkyl ester of an alpha-methylene aliphatic monocarboxylic acid, dissolving in said medium a salt of a perdisulfuric acid with emulsifying agent.

OLEFIN POLYMERS. R. E. Burk and E. C. Hughes (to Standard Oil Co.). U. S. 2,404,788, July 30. Olefins are polymerized by contacting with boron trifluoride and an oxygen-containing compound of aluminum or silicon.

VINYL POLYMERS. D. D. Coffman and F. C. McGrew (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,791, July 30. A resinous material is prepared by emulsifying a vinyl halide in an aqueous medium containing a dissolved salt of a perdisulfuric acid and an emulsifying agent and heating between 0 and 80° C. in a gaseous oxygen-free atmosphere.

COPOLYMERIZATION. D. E. Strain (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,404,817, July 30. Polymers are prepared by mixing asymmetrical dichloroethylene with acrylonitrile in an aqueous solution at a pH between 2 and 4 and containing a dispersing agent and an oxygen-yielding polymerization catalyst, heated between 30 and 60° C.

ALKYD RESINS. H. L. Gerhart and L. M. Adams (to Pittsburgh Plate Glass Co.). U. S. 2,404,836, July 30. A resin comprising a copolymer of cyclopentadiene or dicyclopentadiene and an alkyd resin comprising the unsaturated glyceride oil-modified polyester of a polyhydric alcohol and a dicarboxylic acid.

RESINS. M. T. Harvey (to Harvel Research Corp.). U. S. 2,404,840, July 30. A fusible thermosetting resin is obtained by heating a mixture of lignin and a condensate of furfuryl alcohol as well as formaldehyde.

RESIN. M. J. Scott (to American Cyanamid Co.). U. S. 2,404,892, July 30. A resin is prepared by reacting an aromatic amine with shellac and an aldehyde.

RESIN. A. V. Keller (to Howard Thompson). U. S. 2,404,910, July 30. A plastic composition comprising cellulose treated with an ammoniated solution of a sugar capable of reacting with urea, formaldehyde and a metal salt.

VINYL ESTERS. R. B. Semour (to Monsanto Chemical Co.). U. S. 2,404,929, July 30. A vinyl ester of a halogenated beta-formylacrylic acid.

RESINS. K. L. Berry and J. W. Hill (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,405,008, July 30. The heat shrinkage of an oriented halogen-containing polymer of a monoethylenic unsaturated compound is reduced by heating with an organic curing agent.

DIAPHRAGM. A. J. Jennings (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,405,038, July 30. A flexible, aromatic hydrocarbon resistant coated fabric comprising a nylon fabric base, a thin primer coat containing a thermosetting resin and a butadiene acrylonitrile copolymer, and a top coat comprising a copolymer of butadiene and acrylonitrile.

EXTRUSION. R. S. Jesionowski (to Plax Corp.). U. S. 2,405,039, July 30. A die unit for the extrusion of small shapes of plastic without crinkling or spiralling.

SILICON RESINS. K. N. Mathes and B. A. Wasiewicz (to General Electric Co.). U. S. 2,405,041, July 30. A toluene-soluble methyl polysiloxane resin is mixed with a nitroparaffin and the insoluble portion is recovered.

COATINGS. M. Wilson (to Frederick H. Levey Co., Inc.). U. S. 2,405,249, Aug. 6. A film of a coating comprising a solution of two polar resins having dielectric constants greater than 3 is dried by establishing an electrostatic field, one of the resins having its maximum dielectric loss at the selected frequency when the composition has it lowest viscosity and contains the major portion of the solvent and the other of said resins having its maximum loss when the solution has its highest viscosity, whereby substantially continuous heating is maintained during evaporation of the solvent.

GLOVE. C. F. Ruebensaal (to Glenn L. Martin Co.). U. S. 2,405,329, Aug. 6. Hollow synthetic resin articles are prepared by flowing a synthetic resin about a core having a free end maintained in a mold cavity, engaging said free end, cooling and thereby setting part of the resin while maintaining resin adjacent to the free end in flowable condition, retracting the form from the core and finally cooling and setting the still flowable resin.

RUBBER HYDROCHLORIDE. J. P. Chittum and G. E. Hulse (to United States Rubber Co.). U. S. 2,405,343, Aug. 6. A rubber hydrochloride composition containing a small amount of the reaction product of an aliphatic aldehyde and an ethylene polyamine.

EXPANDED PLASTIC. A. Cooper and D. E. Partington (to Expanded Rubber Co., Ltd.). U. S. 2,405,345, Aug. 6. Re-pressing or shaping of cellular thermoplastic sheets is effected by placing the sheet between the platens of a press provided with rigid distance pieces to arrest the movement of the ram when the desired thickness is attained, heating sufficiently to allow further expansion, releasing pressure and finally reapplying pressure and cooling before taking from press.

PHOTOGRAPHIC ELEMENTS. V. B. Sease and D. W. Woodward (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,405,523, Aug. 6. A coating composition comprising a water-miscible organic solvent having dissolved therein a water-insoluble resinous polyvinyl acetate free from hydroxyl groups, a light sensitive salt, a stabilizer, a diazo coupling component and less than 1 percent of water.

ABRASIVE. D. B. Sharpe and R. A. Baumgartner (to Carborundum Co.). U. S. 2,405,524, Aug. 6. An abrasive article comprising layers of abrasive-included, felted, fibrous sheet material, the bulk of the abrasive particles being distributed internally of the sheet, said layers being adhesively combined in superimposed relation by means of an adhesive binder comprising a phenolic resin.

TERPENE POLYMER. J. N. Borglin (to Hercules Powder Co.). U. S. 2,405,558, Aug. 13. A hard stable resin is prepared by bringing a beta-pinene terpene fraction into contact with boron fluoride as a polymerization catalyst and separating the catalyst from the resin.

MOLDING MATERIALS. H. Kremer. U. S. 2,405,658, Aug. 13. A molding compound comprising a particulate organic fibrous filler, blood and a water-soluble phenol-formaldehyde resin.

SEALER. C. A. Southwick, Jr., and A. F. Stagmeier (to General Foods Corp.). U. S. 2,405,675, Aug. 13. A seal is formed between flat sheets of packaging material having surfaces of thermoplastic material by heating them together under pressure.

RESINS. O. Albrecht, C. Graenacher, R. Sallmann and C. Rossi (to Soc. Chem. Ind. in Basle). U. S. 2,405,806, Aug. 13. A methylene compound in which a ring carbon atom belonging to an aryl nucleus of a resinous ether of a hydroxyaryl compound with a cyclic terpene alcohol or a cyclic terpene hydrocarbon is connected through a methylene or an ether bridge with a water solubilizing quaternary ammonium or thiourea group.

COPOLYMER. G. F. D'Alelio (to General Electric Co.). U. S. 2,405,817, Aug. 13. A hard polymerization product of a mixture of an isolated, fusible partial polymer of divinyl benzene and styrene.

CONDENSATES. J. Treboux (to J. R. Geigy). U. S. 2,405,863, Aug. 13. A process for the manufacture of an acid-soluble condensation product of dicyanodiamide, urea, ammonium chloride and formaldehyde which comprises boiling dicyanodiamide with urea for one hour, in the presence of hydrochloric acid, adding formaldehyde, condensing at 75 to 85° C.

ADHESIVE. R. J. Priepke and J. H. Emigh (to Industrial Tape Corp.). U. S. 2,405,926, Aug. 13. A pressure-sensitive adhesive comprising a condensate of castor oil with a maleic half-ester of a monohydric alcohol.

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The unusual production technique illustrated here was no hit-or-miss proposition. Devised to overcome a problem of mass-production, it indicates that plastics molding, while it has its limitations, also has many novel possibilities in the hands of skilled engineers and mold building craftsmen. It is this knowledge of the possibilities of plastics molding which helps TECH-ART's engineers, mold builders and production men to bring a fresh, flexible viewpoint to each new molding problem—and to come out with the right answers wherever dimensional accuracy, appearance, simplification of design, speed of production or product serviceability is desired.

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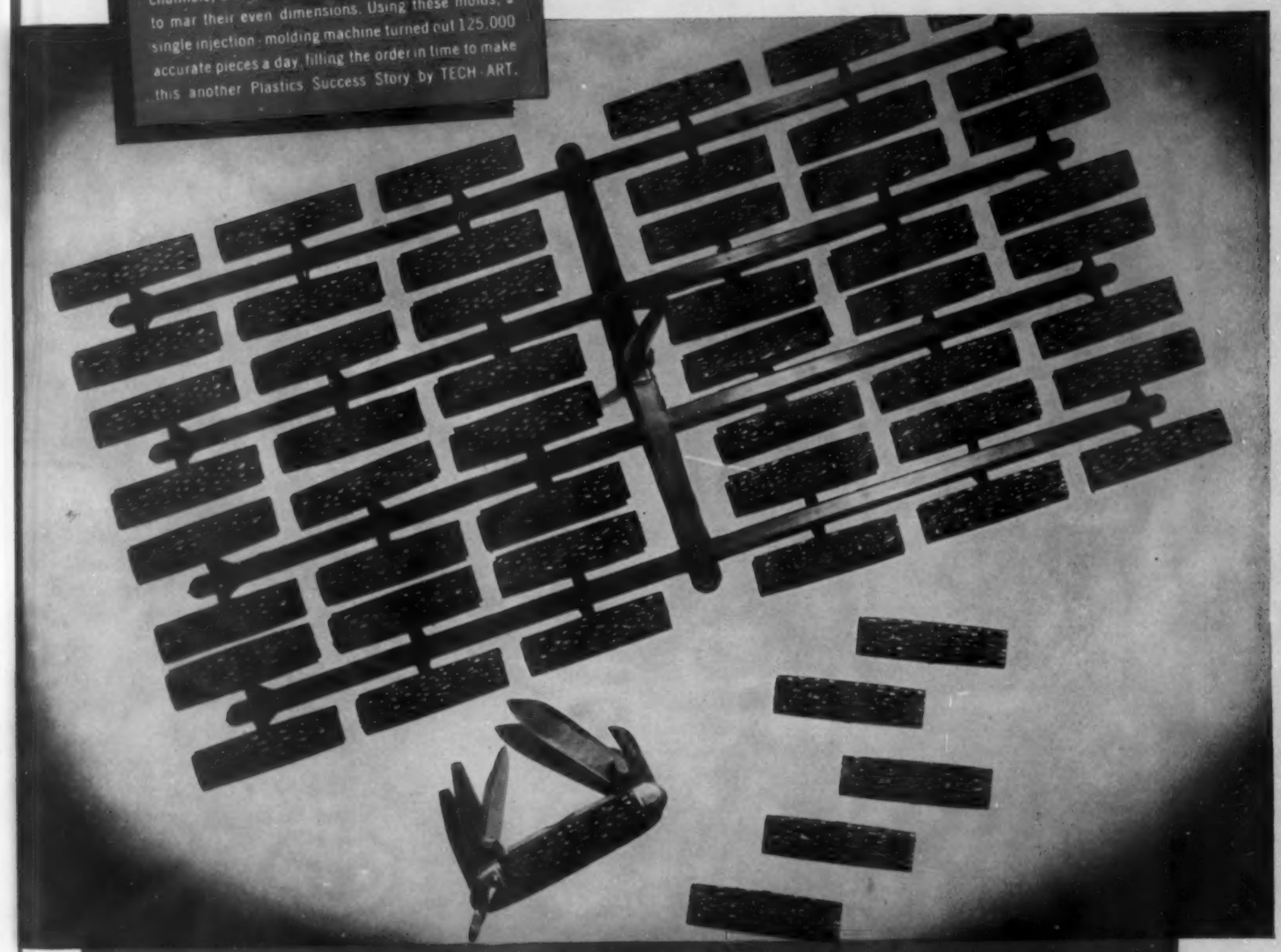

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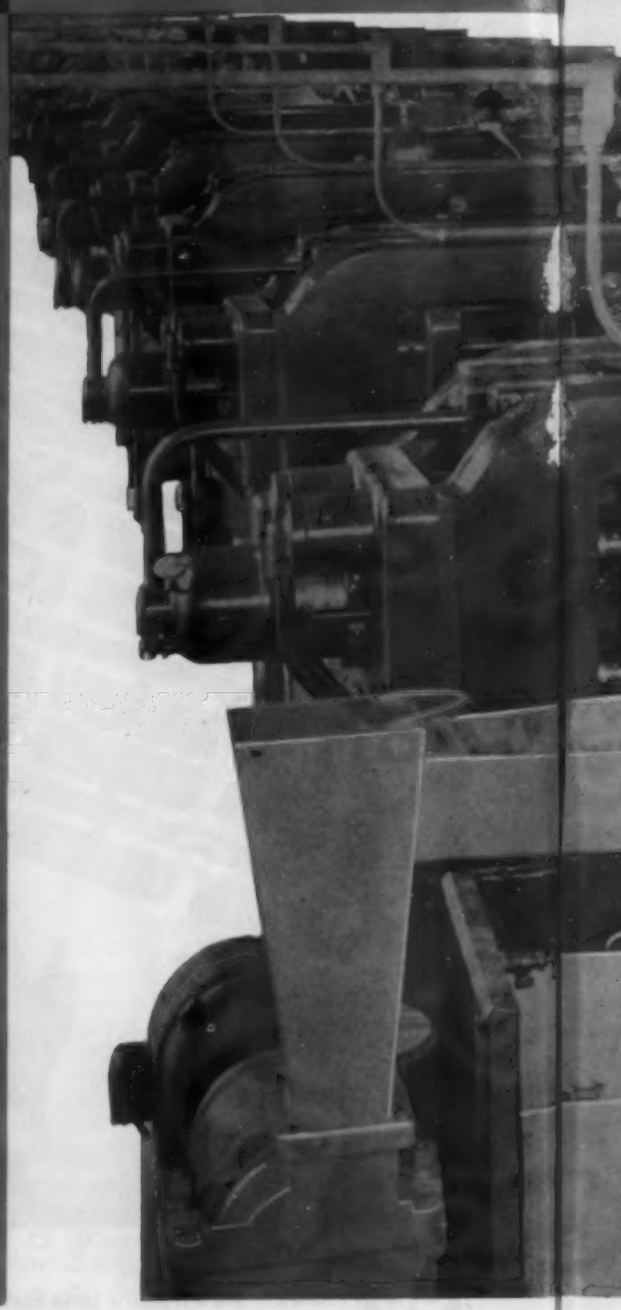

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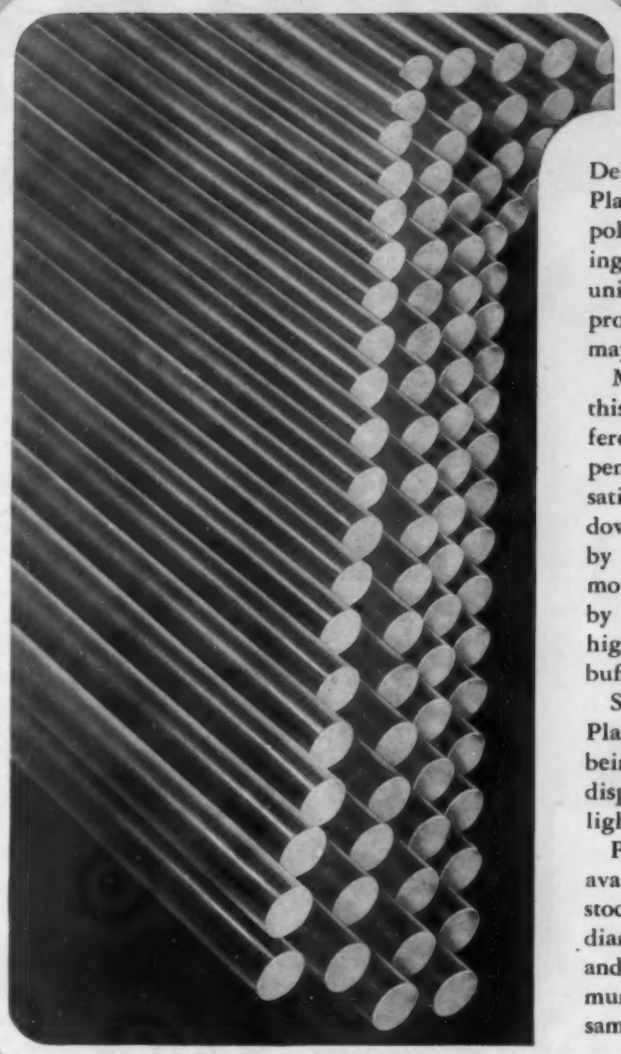

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The RCA Type 2-BHF and Type 100-AV Electronic Power Generators (shown below) furnish exactly the right power for making either large or small seams in most thermoplastic materials.

Generator operation is simple, silent, and automatic. Once set for a specific job, the only control necessary to touch is the ON-OFF button at the beginning and end of a production run.

RCA experience in the relatively new field of Electronic Sealing ranges from air mattresses to watch straps . . . one- to ten-station setups . . . as many as seven different seams in one article, sealed in automatic sequence . . . seals of intricate shape ranging in size from a fraction of an inch to six feet.

We'll be glad to share this experience with you to help you do a better sealing job, faster, at lower cost.

THE RCA TYPE 100-AV Generator connected to a hand-operated applicator—makes a 4 by ½-inch seam in ½ second. (Output: 150 watts, 50% duty cycle; 100 watts, 100% duty cycle.)

THE RCA TYPE 2-BHF Generator. Furnishes the right power (up to 2 kw) for making large seams (up to 6 ft.) in thermoplastic materials and for heating plastic laminates.

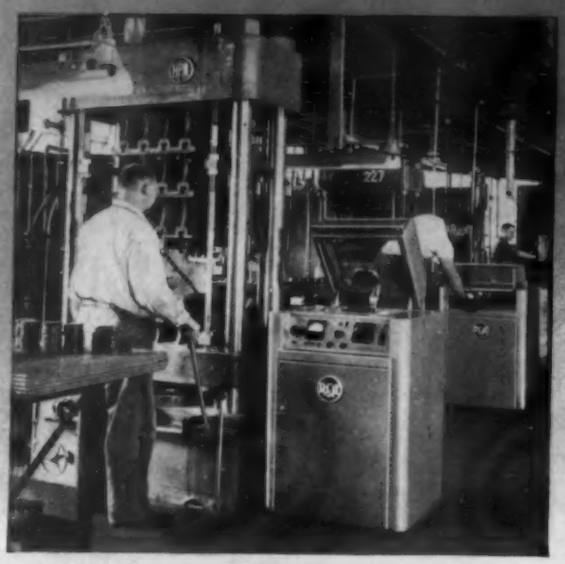
THE RCA TYPE 2-B Generator for heating preforms. First unit to feature the now-famous "pop-open" oven—quickly adopted as standard by plastics industry.

THE RCA TYPE 15-B Generator. Furnishes the right power (up to 15 kw) for heating large preforms.

THE RCA TYPE 100-BM Generator. Furnishes up to 125 kilowatts for special heating applications.

ELECTRONIC HEAT

for Low-Cost Plastic Production



Equipment for Heating Preforms

The 2-kw unit (at left and above) has been helping scores of plastic molders break production records. It is completely automatic. At end of preset time-cycle the power goes off, the "oven" pops open. Heats 24 ounces of material from room temperature to 270 F in 60 seconds.

Other outstanding features include: *automatic* tuning . . . auxiliary infrared heat lamps to prevent surface-cooling . . . wide-opening cage top for easy access to preforms from any angle . . . built-in voltage stabilizer for long tube life . . . approved "dead front" construction, key locks and safety interlocks on access doors.

A similar list of molder advantages apply to the RCA Type 15-B (lower left) for heating preforms. Heats a 7½-pound preform to 270 F in one minute. Other RCA units up to 100 kilowatts (see left).

Equipment for Heating Laminates

If your problem is punching laminates, RCA electronic heating equipment may prove invaluable. In the application shown above—at Kellogg Switchboard and Supply Company, Chicago—rejects on telephone parts were reduced to one per cent using electronic heating just prior to punching. Cracking and chipping practically vanished. The RCA Type 2-BHF Electronic Power Generator is the ideal unit for such jobs.

RCA Help on Other Heating Problems

RCA experience in electronic heating of plastics dates back to the beginning of the art. It includes hundreds of installations ranging from 100 watts to 125 kilowatts output. We'll be glad to help you determine whether your product or process can benefit from electronic heating. Write Dept. 55-L, Electronic Apparatus Section, RCA, Camden, N. J.

ELECTRONIC HEATING

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: R C A VICTOR Company Limited, Montreal

Announcing a Revolutionary Development

LOW-COST COMPOUNDS

...having a wide range of properties and colors requiring no baking; no dwell is required. The cycle is limited only by the speed of mechanical facilities. Suitable for punch press operation.

Available to Licensees IMMEDIATELY For Large-Scale Production

Characteristics

1) Cost is low.
2) No heat is employed during the molding process nor is any baking required.
3) Uses waste materials as filler.
4) Excellent machinability.
5) Can be made water-absorbent, water-repellent, oil-, alkali- and alcohol-resistant or proof.
6) Molds are of simple design.
7) Material is tough and resilient.
8) High speed production—cycle is limited only by press operation.
9) Characteristics of Group H, which formula (when varied to meet special requirements) is used to mold the following:

CASTERS	DOMINOES	SANDAL PLATFORMS
CHECKERS AND CHIPS	DOOR KNOBS	SHAVING BOWLS
CLOCK CASES	FLOOR AND WALL TILE	SHOE HEELS
CLOSURES	PAPER ROLL PLUGS	TEXTILE CARRIERS
CUTLERY AND TOOL HANDLES	PIANO ACTION PARTS	TOILET SEATS
	REELS	TOYS
	ROLLER SKATE WHEELS	

Specific Gravity	1.09 to 1.35—Average 1.20
Weight per cu. in.	16 grams
Tensile Strength	2800 to 8500 lbs per sq. in.
Compression Strength	4000 to 6500 " " " "
Modulus of Elasticity	115,000 to 165,000
Dielectric Strength (with mica filler)	590 volts per mil.
Softening Temperature	350 degrees F.
Water Absorption, 24 hours	average 1.9%
Molding Pressure	Depends upon density of material and ranges from 1500 lbs to 5000 lbs per sq. in.

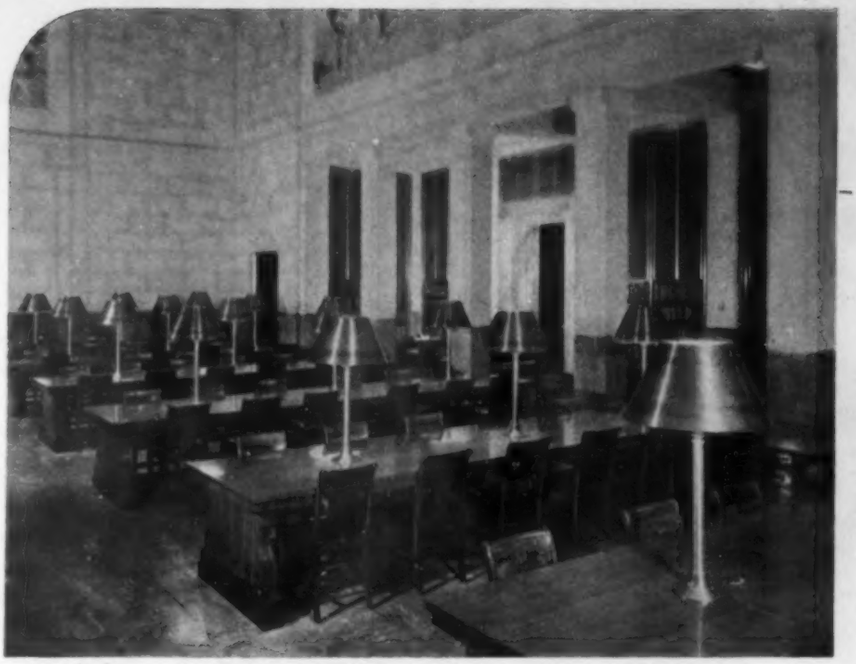
It will be our policy to license a limited number of molders—and in order that our licensees may benefit by the extra savings, we are prepared to mix the powders on the premises of the licensee. He will thus be afforded the free and continuing consulting services of our experts. Also, formulae for special purposes will be developed in our laboratories free of cost to licensee.

Arrangements may be made to see these compounds in high speed cold molding production in the plant of one of our licensees.

Comprehensive patent coverage is being instituted.

EISEMANN PLASTICS CORPORATION

NEW YORK PLANT — 601 WEST 26TH STREET, NEW YORK

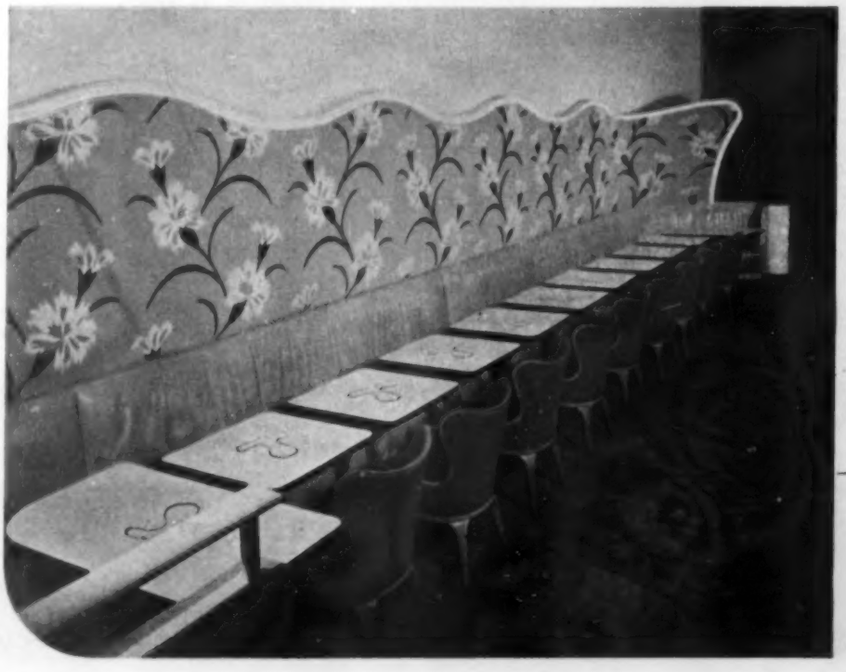


REALWOOD

FOR DIGNITY,

FORMICA laminated plastic surfacing material is so flexible in color and patterns that it is adaptable to any kind of installation from the most dignified and permanent to "jive" color combinations that may be desired for cocktail rooms or theaters. ¶The color photograph shown above represents the reading tables surfaced with Formica "Realwood" in the reading room of the annex to the Congressional Library in Washington, where a great deal of Formica was used both for dignity and durability. ¶Below is the cocktail lounge of the Statler Hotel at Washington where something livelier was desired. ¶In either case the practical wearing qualities of the material are the same. It is non-porous and unstainable, cigarette-proof on horizontal surfaces, washable with soap and water or with solvents—and extremely long wearing and durable. There is no painting or refinishing required ever—no maintenance, no time out of service, no trouble.

THE FORMICA INSULATION COMPANY, 4639 SPRING GROVE AVENUE, CINCINNATI 32, OHIO



Color

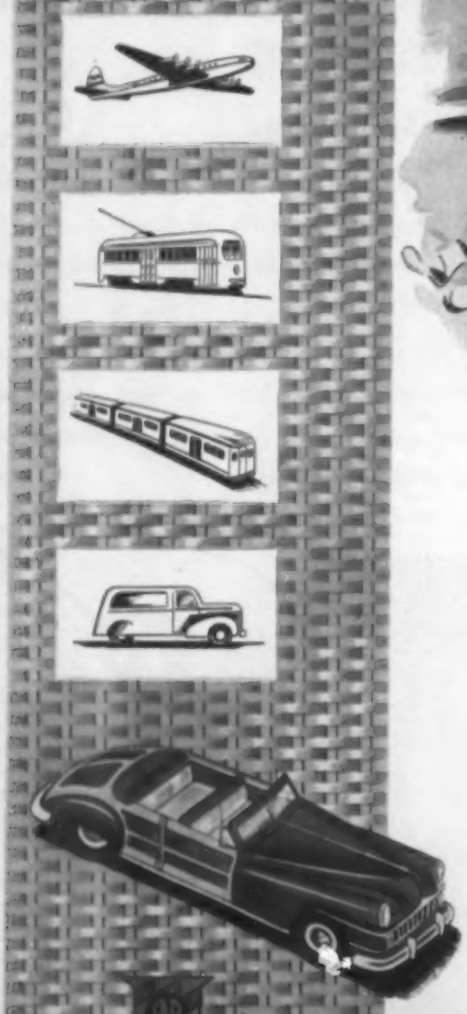
FOR A THRILL!

FORMICA

TRADEMARK REG. U. S. PAT. OFF.

Saran BY NATIONAL

THE SEATING MATERIAL THAT'S GOING PLACES



SARAN BY NATIONAL is making a definite contribution to the field of public transportation with a revolutionary seating material. To all appearances, SARAN seating is woven in the style of the familiar "rattan" which served faithfully in its day. But SARAN carries on where other materials stopped.

Unusually tough and durable, SARAN rattan resists rough treatment, defies dirt, suffers no ill effects from mud, grease and perspiration. Even inks and acids, which stain, discolor and destroy ordinary seating material, don't phase this smoothie!

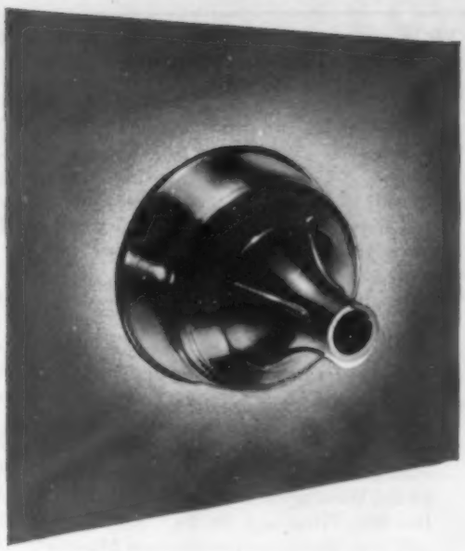
SARAN rattan is proving its serviceability in New York's vast subway and bus systems . . . and in America's better sport cars.

We'll be glad to tell you more about the possibilities of SARAN BY NATIONAL for any type of transportation in which you might be interested. Please write on your company letterhead.

NEW YORK: EMPIRE STATE BUILDING

The NATIONAL Plastic Products Company

ODENTON . MARYLAND



SMALL PLASTICS ON A BIG SCALE

Owens-Illinois is proud of its reputation as a *specialist* in small plastics.

The automatic machines that mold our precision closures also produce millions of thermo-setting plastic units—designed for hundreds of different uses. Each conforms to the exacting Owens-Illinois standards of strength and uniformity.

Owens-Illinois "know-how"—based on both research and production experience—assures a combination of speed and economy on volume production. If you need small plastic units in large quantities, we are ideally suited to serve you.

LOOK FOR THIS TRADE MARK

PLASTICS DIVISION

OWENS-ILLINOIS GLASS COMPANY

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Books and Booklets

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery.

What Industry Owes to Chemical Science

Published by Chemical Publishing Co., Inc., 26 Court St., Brooklyn, New York, 1946

Price $5.00 **372 pages**

More than 50 authorities have contributed to this symposium, based on a scheme by R. B. Pilcher and F. Butler-Jones. The chemist's place in industry is treated with reference to synthetic resins, thermoplastic and thermosetting plastics, agriculture, building materials and textiles—to mention only a few of the fields covered. Although originally published in 1918, the book has been revised and enlarged to include the most recent strides in scientific industry and is as timely now as when it first appeared.

Plastics

by V. E. Yarsley and E. G. Couzens

Published by Penguin Books, 245 Fifth Ave., New York, N. Y., 1945

Price 9 pence **159 pages**

This compact manual gives a scientific description of the raw materials, processing and functions of the plastics industry. The survey covers not only the production of molded plastic products, but also that of laminated or reinforced materials. Included is an account of the present uses of plastics and their future possibilities with emphasis on the importance of chemistry and engineering to the success of the entire industry.

Reference material—SPI has announced that the second revised edition of "Plastics—The Story of an Industry" is ready for distribution. Various chemicals and resins and their application to modern life, as it is served by the plastics industry, are discussed with the aid of diagrams and a two-page color plate. The booklet is available for a nominal cost at SPI offices, 295 Madison Ave., New York 17, N. Y.

Color conditioning—Illustrating and describing years of research and practical experience with color to increase production, improve seeing conditions and create a better working environment, "Du Pont Color Conditioning for Industry" makes clear the fundamental principles on which color conditioning is based. The booklet is available upon request to the Finishes Div., E. I. du Pont de Nemours & Co., Inc., Dept. M-6, Wilmington, 98, Del.

Another booklet recently issued by the Finishes Div. describes a new liquid adhesive, No. 4665 cement, which is extremely suitable for bonding metal foils and metal sheets to wood, plastics, vulcanized synthetic and natural rubbers, as well as other substances having widely different coefficients of thermal expansion.

Bearings and bushings—Complete data on stern tube bearings, pintle bushings and other marine Micarta products, as well as a discussion of the characteristics of this heavy-duty thermosetting plastic, are included in a recent Data Book announced by the Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. Also available is an illustrated pamphlet on Micarta roll neck bearings for use in steel mills.

Custom injection molding—Worcester Moulded Plastics Co., 14 Hygeia St., Worcester, Mass., has prepared a pamphlet discussing the advantages of custom injection molding as it is handled in their company.

Control systems—Milton Roy Co., Philadelphia 18, Pa., has just issued Bulletin 468 explaining their automatic proportioning and ratio control systems. Three entirely new flow sheets supplement the illustrations and clarify this automatic chemical metering and pumping.

Die-cutting—Accurate steel rule cutting dies for cutting flat, soft and semi-soft sheets to any flat size or shape are discussed in a pamphlet printed by Accurate Steel Rule Die Mfrs., 22 W. 21st St., New York 10, N. Y. The materials now successfully being cut by this method include plastics, rubber, cork, felt, cardboard, paper, cloth, leather, plywood, untempered masonite, wall board as well as thin metals.

Research laboratories—Bulletin 113, the 8th edition of "Industrial Research Laboratories of the United States" has been published by the National Research Council, National Academy of Sciences, Washington, D. C. An appendix is included for the first time, listing colleges and universities which offer research service to industry.

Sharpening of twist drills—Pointers on the sharpening and web thinning of twist drills, as well as the dimensions and angles of points which give the best results in drilling various materials, are presented in a 24-page manual distributed by Republic Drill & Tool Co., 322 S. Green St., Chicago 7, Ill. Also received from this Company is a 4-page illustrated bulletin giving complete information on the new Republic line of mechanics-length speed drills.

Transfer molding pressures—Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. has brought out a booklet containing a thorough explanation of transfer molding. Charts and diagrams supplement the text.

Modifiers—Three short monographs on alkenyl succinic acid anhydrides, alkenyl succinic acid anhydrides in resins and alkenyl succinic acids have been received from Solvay Process Co., 40 Rector St., New York 6, N. Y. That on alkenyl-succinic acid anhydrides covers physical properties, chemical properties and applications. The monograph on alkenyl succinic acid anhydrides in resins discusses the preparation of alkenyl resins and the nature of ASAA alkenyl resins; that on alkenyl succinic acids deals with its preparation and many uses.

Outlets for plastics—Now available is "A trip through Hercules land," which explains how products of Hercules Powder Co., Wilmington 99, Del., are utilized in such major industries as plastics, adhesives, protective coatings, synthetic fibers and textiles.

Allyl ester casting resin—The properties and processing information for Kriston, a thermosetting allyl ester casting resin, are contained in technical bulletin PM5, recently published by B. F. Goodrich Chemical Co., Rose Building, Cleveland, Ohio. This allyl ester requires very moderate temperatures and no pressure to cure and is available from the company only in its natural uncolored monomer form.

Preswoods—The Masonite Corp., 111 N. Washington St., Chicago, Ill., has just brought out its annual report. Included are reproductions of the company's current series of 4-color advertisements, illustrations of Preswoods in use and a balance sheet for the year ending August 31.

Protective strip coatings—A new explanatory leaflet, "Protective Strip Coatings of Eastman Cellulose Acetate Butyrate" has been issued by Tennessee Eastman Co., Kingsport, Tenn. It describes in detail the preparation and application of continuous tough coatings to be used for the protection of various metal parts

Get 10,000 megohms insulation resistance after wet cycling . . . with RESINOX 490*

LAMINATING VARNISH

Here for the first time is a laminating varnish that can deliver up to 10,000 megohms insulation resistance after wet cycling according to the JAN-P13 procedure.

In addition, Resinox 490 imparts to laminates excellent power factor, dielectric constant, and loss factor . . . also exceptionally good hot punching characteristics.

If you manufacture or use these materials, why not specify Resinox 490 as the laminating varnish . . . and take advantage of extra, important qualities. For complete data on this application or on other post-forming or general-purpose laminating varnishes . . . simply address: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts. In Canada: Monsanto Ltd., Montreal, Toronto, Vancouver.

MONSANTO CHEMICALS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Resinox: Reg. U. S. Pat Off.

against "corrosion and abrasion in transit and storage." These transparent coatings are said to be easily stripped from coated objects and meltable for re-use.

Armored rotameters—Data relating to selection, design and dimensions of a variety of flow rate instruments suitable for high-operating pressures and temperatures are contained in a bulletin just released by Fischer & Porter Co., Dept. 9G-7, Hatboro, Pa. Also shown in this new booklet are recording, controlling, integrating, remote and close-coupled instrument accessories.

Continuous vat dyeing—Riverside & Dan River Cotton Mills, Inc., Danville, Va., are sending out to the textile industry a pamphlet entitled "Continuous Pigment Vat Dyeing." The booklet describes the process briefly and also publishes the text of the company's patent and of their licensing agreement.

Resistance welding—A new enlarged edition of a bulletin describing Ampcoloy resistance welding electrodes and alloys has just been issued by Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 4, Wis.

Precision gages—Sturdy Tool & Gage Co., 14520 Schaefer Highway, Detroit 27, Mich., describes its line of new steel, chrome plated, tungsten carbide and Norbide gages in a recently issued 4-page pamphlet. Jigs, fixtures and non-cutting tools of the same materials are also treated.

Automatic proportioning equipment—A catalog, from % Proportioneers, Inc. %, 9 Codding St., Providence 1, R. I., aids the purchaser in the selection of equipment for most treating, sampling, blending and diluting applications. The operations, capacities and applications of the Treet-O-Control meter are thoroughly covered.

Friction tap holder—A folder has recently been released which describes in detail the Procunier style "C" friction tap holder, designed for use on reversible machines. This folder is available without charge from Procunier Safety Chuck Co., 18 S. Clinton St., Chicago 6, Ill.

Milling machines—Illustrated descriptions and specifications of No. 2 MI milling machines are contained in a catalog just brought out by Cincinnati Milling Machines Co., Cincinnati 9, Ohio. The MI milling machines are built in No. 2 size; plain, universal, vertical styles.

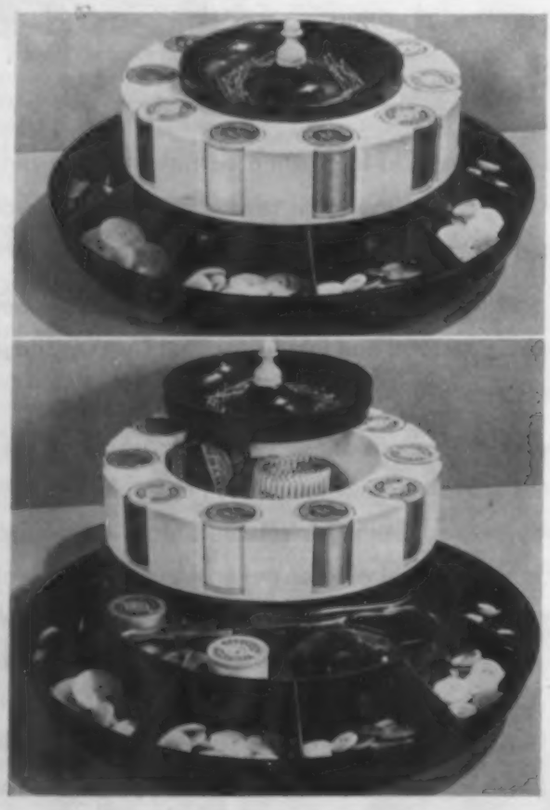
Air-operated hydraulic presses—Air-hydraulic presses having ram pressure controlled up to 5000 lb., an adjustable stroke of $^1/_{16}$ to 5 in. and adjustable ram speed, are described in a new 8-page bulletin by Air-Hydraulics, Inc., 401 Broadway, New York 13, N. Y.

Price list—United States Testing Co., Inc., Hoboken, N. J., is offering a price list of tests covering every branch of modern industry.

Fatty acids—The Twitchell Div. of Emery Industries, Inc., 4300 Carew Tower, Cincinnati 2, Ohio, has recently published Section II of Emery facts, a loose-leaf booklet describing the chemistry and uses of fatty acids.

Metal spraying—The October issue of *Metco News*, published by Metallizing Engineering Co., Inc., 38–14 30th St., Long Island City, N. Y., tells how metal spraying has reduced the cost of replacing a rudder stock liner, has restored the bearing journals of large ammonia compressor.

A NEWCOMER TO THE SEWING CIRCLE is this handome 3-piece, all-plastic Stitch Kit. Overlooking none of the sewing necessities, the kit has compartments for needles, thread, scissors, buttons, thimbles and pins. The thread tray is a Lazy-Susan in its own right, easily spun to make for quick selection of spool. Removable trays conserve space, make sewing implements more accessible and greatly simplify the job of cleaning the unit.

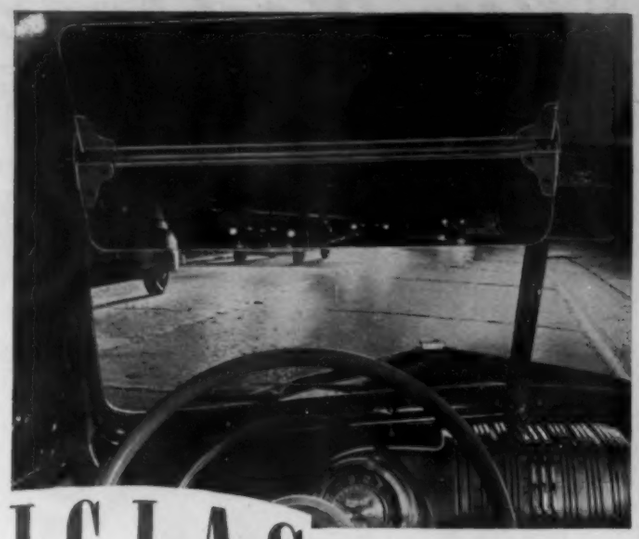


Having a total weight of 14 oz., the kit is molded in black and ivory Tenite II. The Lakone Co., Aurora, Ill., molds the device for the Covel Co. on an 8-oz. injection machine. Single cavity molds are used on the 10-compartment button tray, measuring 9 in. in diameter, and the spool tray, which is molded with lugs that telescope into the lower section. The pin dish is produced in a 2-cavity mold, while the ivory handle, secured to the pin dish with butyrate cement, is made in a 20-cavity die.

The two larger trays are molded with center sprues—a double knockout system being employed on both to facilitate stripping them from the molds. A center knockout bar pushes the large center core up, elevating the casting about three quarters of an inch. Then the mold is partly closed and the two side knockout bars are pulled down manually, stripping the molded pieces from the large center core.

In the case of the large button tray section, this knockout system is used to prevent possible damage to the numerous partitions in stripping the piece from the mold.

NIGHT and DAY...



PLEXIGLAS

KEEPS GLARE AWAY!

Sky glare, road glare and bright-light glare are cut down to the very minimum by the new O-Q Visor. Made of two sheets of green PLEXIGLAS of special color density by the Earl A. Thompson Manufacturing Company of Detroit, the O-Q Visor is simply attached to regular car visors, easily swung into position to meet any light conditions. ¶ Easily molded or fabricated, PLEXIGLAS will efficiently carry out your design ideas. That's why so many manufacturers are using this acrylic plastic—crystal-clear or colored—for so many automotive applications. ¶ Your designs will benefit from the many advantages of PLEXIGLAS, including its light weight, strength and shatter resistance. For detailed information, call or write our Detroit representative: W. E. Biggers, 819 Fisher Building, Madison 1500.

Only Rohm & Haas makes
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Acrylic Plastic Sheets and Molding Powders

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ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile, Enameware, Rubber and other Industries

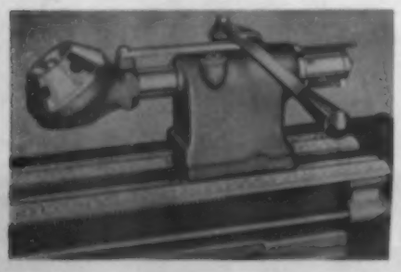
New Machinery and Equipment

Injection molding machine—Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich., has introduced a new 2 oz. plastics injection molding machine, its first production under its own name in the plastics field. Although rated at 2 oz., the machine, Model 1M-2, was designed and built with a 50 percent overload capacity to handle a wide range of small plastics parts and products. Two electronic controls regulate the heat in the chamber and nozzle indefinitely without danger of burning the material. A new type electronic control, mounted on the machine panel in such a way as to be unaffected by machine vibration, guarantees accuracy of ±2°.

Clearance of 12½ in. is provided between strain bars both in top and sides. Plates are 18 by 18 by 4⅝ in. When operating at 1000 p.s.i. line pressure, maximum pressure of the injection plunger is 28,400 p.s.i. Injection stroke has 3 sec. cycle for full 8 in., traveling at 100 ft. per minute. Two timers control mold clamping, injection time. Other specifications: cubic in. per shot, 2.75; mold opens, 8⅛ in.; maximum casting area, 20 sq. in.; mold clamping pressure, 135 tons; length, 108 in.; width, 30 in.; height, 51 in.

Heavy duty drill—A new addition to the line of twist drills, reamers, etc., put out by Chicago-Latrobe Twist Drill Works, Chicago 10, Ill., a division of United Drill & Tool Corp., is a heavy-duty drill designed for use on tough and hard materials such as heat-treated steels up to 375 Brinell hardness. Sizes range from ½ to 1½ in. in diameter.

Handlever turret—A new tailstock-type handlever turret has been introduced by the South Bend Lathe Works, South Bend 22, Ind. Designed to give turret lathe efficiency to the company's 9 in. lathes on jobs requiring a number of successive operations, this turret mounts on the inside ways of the bed in place of the tailstock. Tools with ⅝ in. diameter shanks are accommodated by the six-station turret head. Stop mechanism is geared to operate automatically in unison with the indexing of the turret head. Operations can be repeated or skipped at will. Turret slide has a maximum stroke of 3¼ inches.



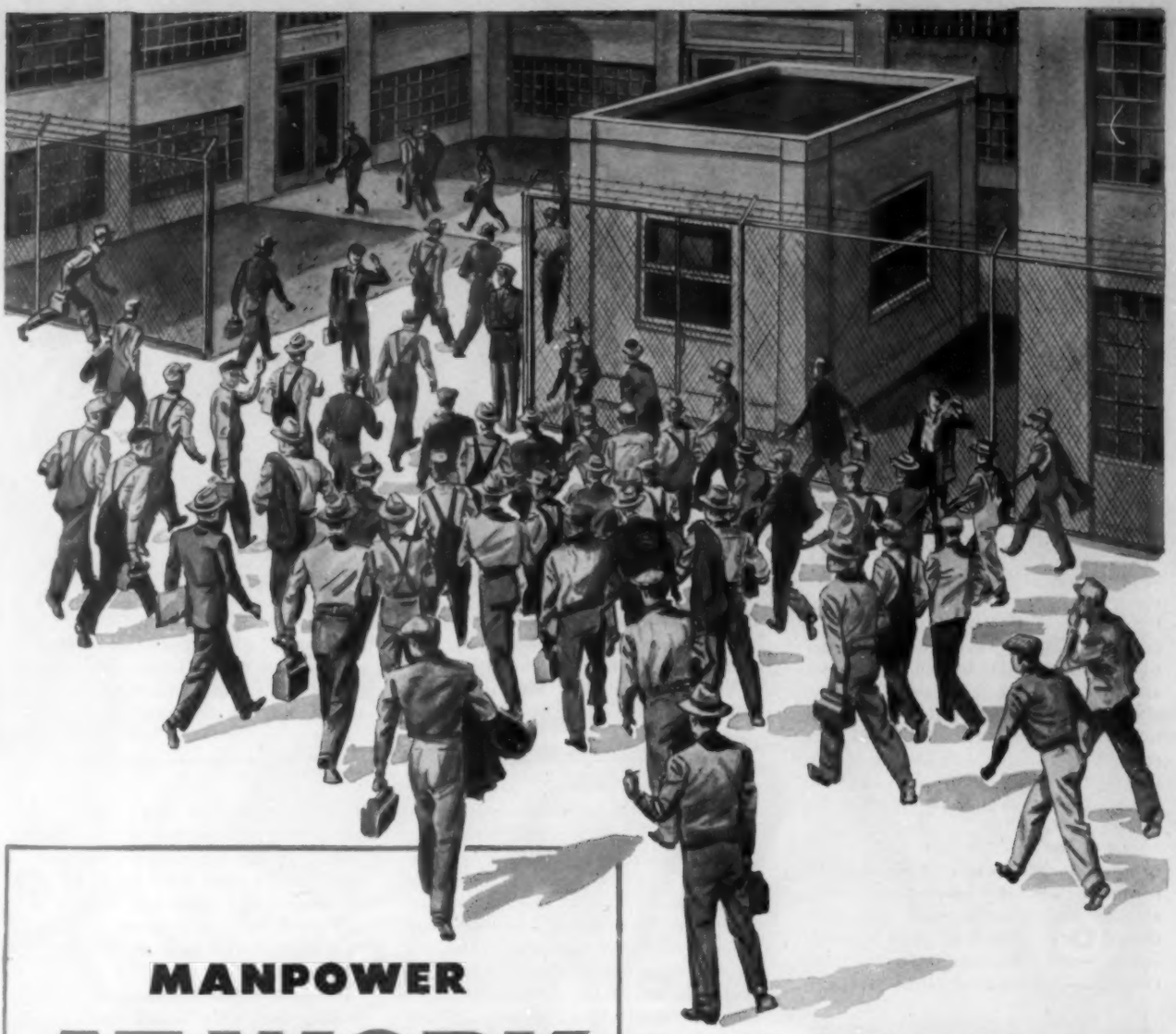
Marking unit—James H. Matthews & Co., 3942 Forbes St., Pittsburgh 13, Pa., has developed an "Airgrit" marking machine for marking delicate or precision parts having a ground or mirror surface that should not be marred or distorted. The marks are made by means of a blast of fine grit against rubber or celluloid stencil masks upon which the part to be marked is placed. Operated by air pressure, the unit is equipped with an electric timing unit as an aid to uniform and legible marking. Specifications are: Height, 34 in.; floor space, 18 by 15 in.; operating air pressure at nozzle, 10 lb.; maximum area of blast, 4 by 3 in.; size of air feed line, 1 in. in diameter; amount of grit used in unit, 3 pounds.

Heat sealing machine—The Cleveland Lathe & Machine Co., 5511 Euclid Ave., Cleveland, Ohio, has announced the Crimpmaster portable hand-operated bag sealer as a companion unit to the Model B foot operated heavy duty bench type. With heating elements in both serrated sealing jaws, this unit can be used for sealing wrappings and bags containing all kinds of foods, drug sundries and small merchandise. Pressure is applied by the back of the hand, allowing both hands free to hold any size bag. Of aluminum, the machine is designed for 110 volts AC and consumes 120 watts. It is 9 in. wide, 10½ in. long and 11½ in. high.

Precision vise—An all angle vise suited for die, gage and fixture drilling and grinding work has been announced by the Machinists Tool Co., 2834 West Lake St., Chicago 12, Ill. It is adapted for use on grinders, drill presses and other machine tools as well as for bench applications.

Any vertical or horizontal angle can be set quickly and the Driv-wheel movement of the vise gives a 2¾ in. lateral clearance. In addition to hardened, ground and replaceable jaws, V-grooved jaws are provided. The vise swivels 360° on base and has 90° vertical angle adjustment.

High-speed dissolver—The Cowles Co. of Cayuga, N. Y., has announced a new high-speed dissolver which under field tests has shown itself to be from 2 to 20 times faster on standard dissolving and dispersing operations. The new machine ex-



MANPOWER AT WORK BOOSTS PURCHASING POWER!

Records of the average income of all wage-earners for the past quarter century show an increase of 150% in "real" hourly earnings . . . "real" weekly earnings nearly doubled. Many industries exceed the "average". Industry's ability to create better products that improve living standards, and industry's ability to pay higher wages and higher taxes, come solely through increased production. Slow-downs, or idleness, reverse the advances. Most people know, and admit, these facts. Many need to be reminded often.

MOSINEE paper technicians are helping manufacturers improve their products and production. Call MOSINEE.

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

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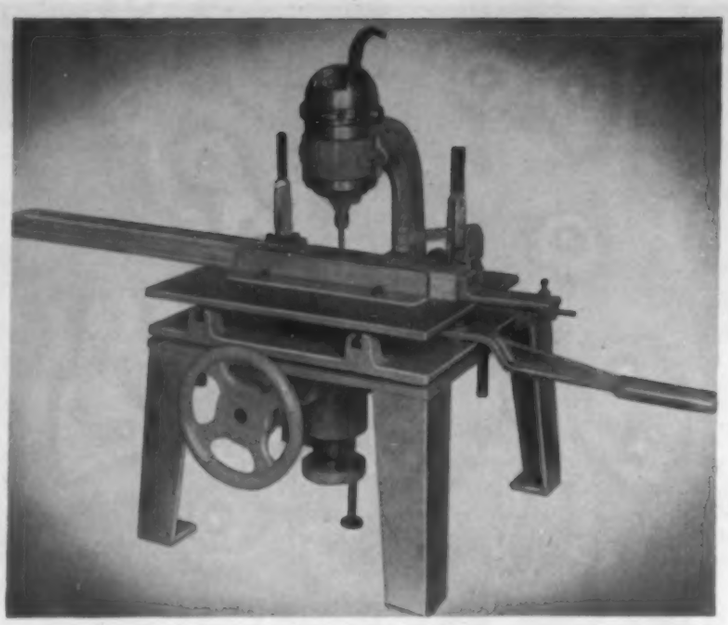
poses broad area of molecular contact between the solvent and solute, subjecting every particle of the material being treated to molecular tension and scrubbing action, increasing dissolving and dispersing action. Two types are available. One model has the tank permanently incorporated in the unit with capacities of 100 to 500 gallons. The second model has an elevating head, designed for use with user-furnished portable tanks. The design of the impeller, size of motor and tank material are specified for each job by the company's engineering staff.

High speed production chuck—The Rayco Mfg. Co., 3911 South Prairie, Chicago 15, Ill., has announced a new high-speed production chuck for drill press and hand power tools which permits quick tool changes without shutting off the power tool. Utilizing the principle of centrifugal force to move a ground and hardened driver into the adapter slot, the chuck operates in all positions at any speed. An upward movement of the outer sleeve of the chuck releases the centrifugal driver, permitting withdrawal of the adapter and tool. When the next tool and its adapter are in place, a downward movement of the sleeve releases the centrifugal driver and tool is ready for work. It is said tool changes can be made in three seconds with the power tool operating anywhere in speed ranges up to 20,000 r.p.m. Centering is automatic.

All-purpose bench saw—Flexsaw, a new bench saw specially adapted to cutting acrylic, methyl methacrylate and other thermoplastics as well as wood has been announced by Flexsaw Mfg. Co., 122 Grindstone, Port Austin, Mich. It is said

to be extremely accurate in producing straight and bevel rip, miter and compound miter cuts, grooving and polishing. It has capacity for cutting materials up to 3 in. thick and up to 15 in. wide. Power is supplied by a 1 hp. motor mounted on the frame. Flexible shaft drives blade.



Slotting and drilling machine—J. T. Lloyd, Bourse Bldg, Philadelphia 6, Pa., has introduced a machine for cutting slots in Venetian blind slats, for cutting and drilling of small plastic parts, wood, aluminum and steel. The machine will also take care of grooving straight or circular parts. Foot or hand operated, the machine has a $^{3}/_{4}$ hp. motor with a speed of 18,000 r.p.m. A ground bit is furnished.

Rubber floor tile cutting machine—A machine which cuts floor tiling into blocks 4 in. sq., in graduations of 1 in., has been developed by the Campbell Machine and Development Co., 1734 Front St., Cuyahoga Falls, Ohio, and is being manufactured by the Falls Engineering & Machine Co. Cuyahoga Falls. Model 72, built for plastic tile and rubber tile manufacturers, will take a sheet with a maximum width of 72 in. It will also cut oblong blocks within the 4 in. to 24 in. sq. range. In tests, it has cut tile up to $^{1}/_{4}$ in. thickness. It will take either roll or block tile and will cut feature or border strips to a maximum of 6 ft. in length. The company is preparing to build two other models, Model 54 and Model 42.

Coolant pump—As an accessory to machines where a free flow of coolant is required, the Delta Manufacturing Div., Rockwell Mfg. Co., Milwaukee 1, Wis., announces a new coolant pump. The flat machined flange permits use on most wet machine tools. The pump has capacity up to 30 gal. per min. at low heads and will deliver water up to 2 gal. per min. to a 14 ft. head. The $^{1}/_{4}$ hp. motor is double-sealed and has lubricated-for-life ball bearings. Seven different units are available with different motor types.

Lathe collet stop—For second operation work, Hardinge Brothers, Inc., Elmira, N. Y., has introduced a new universal lathe collet stop. This stop will convert any standard 1 in. capacity lathe collet into a solid stop or spring ejector stop collet without alteration of the standard collet. It will automatically eject parts from a collet when the collet is open. A set consists of a collet stop body, a large and small solid stop insert and spring ejector insert with necessary wrenches.

Electronic input controller—For controlling electrically heated equipment in the plastics industry, such as curing and baking ovens, press platens, melting and mixing kettles, the Automatic Temperature Control Co., Inc., Philadelphia 44, Pa., has announced an electronic input controller. A positive-acting mercury relay is incorporated which permits accommodation of heating loads up to 30 amps. (110 volts, AC) without necessity of using an intermediate contactor.

Midget pump—The Superdraulic Corp., Dearborn, Mich., has announced the Superdraulic junior pump $5^{7}/_{8}$ in. in diameter and weighing approximately 32 pounds. It is a duplicate of the company's 40-hp. constant delivery pump and has a performance of 5000 p.s.i. in continuous duty service. The single bank of plungers delivers 3 g.p.m. at 1800 r.p.m. and 2 g.p.m. at 1200 r.p.m.

Drilling machine—A high-production center drilling machine with automatic centering and clamping is now being produced by the Detroit Tap & Tool Co., 8432 Butler Ave., Detroit 11, Mich. It is said that the machine's operation requires

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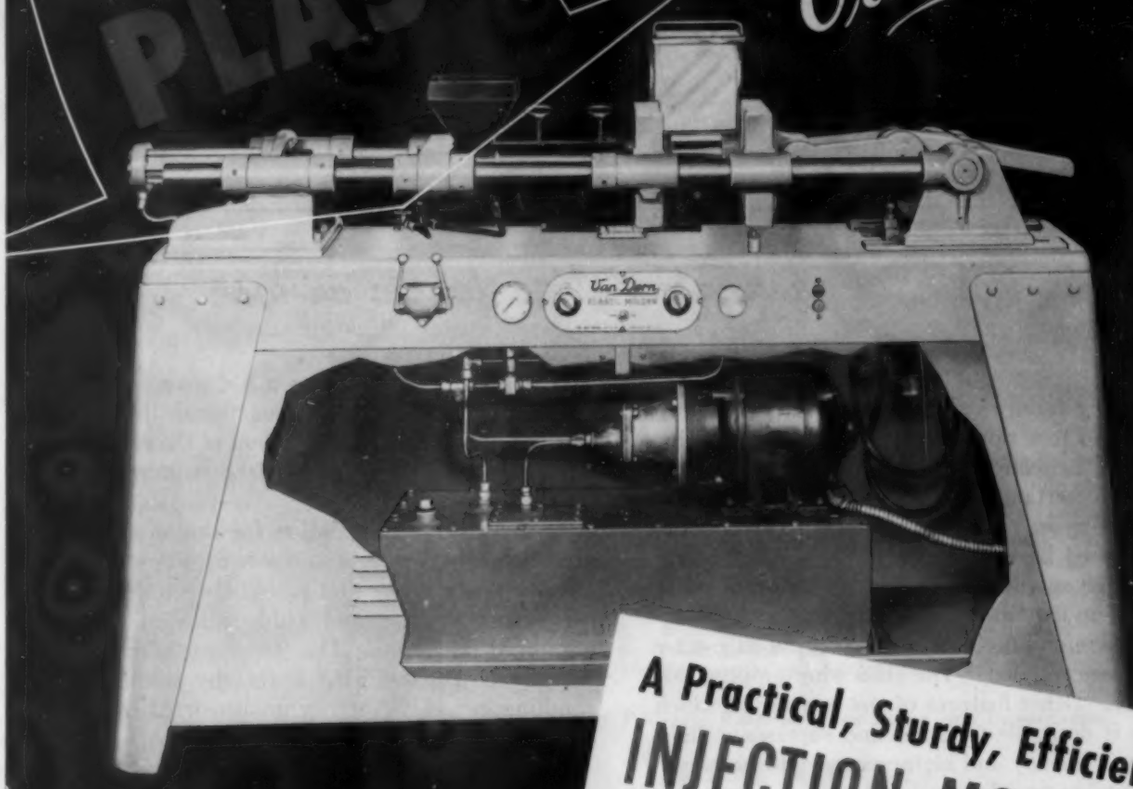

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a minimum of skill for such operations as concentric centering. A single lever controls the positioning, clamping and feeding of the drill. A wide range of shapes and sizes can be handled. Concentric centers may be drilled in round and square stock ranging from $^1/_8$ to $2^3/_8$ in. outside diameter. The drill has three speeds—1250, 2400 or 5200 r.p.m., obtained through a V-belt step pulley derived from the spindle drive motor. Another motor drives the gear type hydraulic pump through a flexible connection. The spindle chuck has a center drill capacity of from A-1 to J-2 ($^1/_8$ to $^1/_2$ in. OD).

Crane—A portable Gantry crane with 1 ton capacity has been announced by the Industrial Equipment Co., 315 North Ada St., Chicago 7, Ill. The legs of the crane are welded in jigs for precision squareness. The casters have semi-steel wheels that operate on roller bearings while the swivel unit of each caster is equipped with ball thrust-type bearings. The crane can be used at loading platforms and docks, in power plants, machine ships and factories.

Electric hoist—A heavy-duty electric hoist known as the Bob-Cat has been developed by the Lisbon Hoist & Crane Co., Lisbon, Ohio. The eight available types with their capacities are: 1-A, 2000 lb.; 2-A, 2000 lb.; 3-A, 1000 lb.; 4-A, 1000 lb.; 5-A, 3000 lb.; 6-A, 3000 lb.; 7-A, 4000 lb. and 8-A, 4000 pounds. Net weight without trolley ranges from 356 lb. for 1-A to 391 lb. for 8-A. All are equipped with $1^1/_2$ hp. motors. Lift speed is 22 ft. per min. for 1 ton and 41 ft. per min. on $^1/_4$ and $^1/_2$ ton. Three types of controls are available, the push button, thumb lever and two pendant ropes with a handle on the end of each—one for raising and one for lowering. Equalizing solenoid brakes as well as two Weston-type mechanical brakes, ball bearings throughout, a double internal gear train of spur gears, $^5/_{16}$ in. wire cable and safety factor of 6 to 1 are other features.

Temperature control—The Xactline straight line temperature control for maintaining accurate process heats for plastic molding, drawing, tempering, heat treating and other similar applications has been announced by Claud S. Gordon Co., 3000 South Wallace St., Chicago 16, Ill. According to the company, the unit will operate as close as $^1/_2$ over a normal range of operating cycles and will respond to a millivoltage impulse up to 90 percent less than that required to actuate many conventional pyrometer controllers. On-off power cycles are as low as 3 seconds. The internal relay is the only moving part.

Resin impregnated glass fabric wings

Recent tests by the Army Air Forces of an aircraft wing fabricated entirely of glass fiber may soon open new opportunities for the plastics industry. Indications are that the new wing will overcome certain limitations of the conventional metal wing in modern aviation's attack on the sonic speed barrier.

At high speeds the slightest scratch on a wing can set up extreme turbulence. Surface smoothness, therefore, becomes more essential as greater speeds are reached. The glass wing supplies this surface. Other features of the new airfoil which make it desirable for sonic and supersonic flight are its resiliency and high resistance to heat.

The wing was designed and built by Army Air Force engineers of the Air Materiel Command at Wright Field, Ohio. The toughest problem these engineers faced was developing a plastics structure to replace a component originally designed for metal. The new wing had to carry a load comparable to that carried by a metal wing. When testing was completed, it was found that the plastic wing withstood 105 percent of the required design load, its glass-like surface unmarred by wrinkling or buckling.

The method of fabrication for the wing is a sandwich type, comprising a low density cellular cellulose acetate core that is set between thin but high-strength inner and outer skins of glass-reinforced laminates. The structural bracing of the standard metal wing is thereby eliminated, resulting in a clean interior unobstructed by ribs and other usual bracing devices.

Simply constructed molds were used to form the experimental wing in two sections. Beam flange elements were molded into each half and joined together by longitudinal bonding. The layers of cloth laid in the wing mold were woven from glass fibers impregnated with resin in a semi-automatic coating machine. The core of the sandwich comprised strips of light weight cellular cellulose acetate (with a density of 6 pounds per cu. ft.) wrapped in a thin layer of glass cloth. Pressure and heat cured, this wet lay-up hardened into a structure of greater stiffness and smoothness than the conventional metal sheet used on aircraft structures.

Advantages of the new wing are its ease of maintenance, its smooth uninterrupted surface and its electrical and insulation characteristics. Repairs can be accomplished without altering the integrity of the plastic structure.

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News of the Industry

The Society of Plastics Engineers has released further details on its plastics show and convention to be held next month in Chicago.

The schedule for the show, which will be staged at Navy Pier, has been altered slightly to run from Saturday, January 25 through 31. The dates of the technical meeting at the Congress Hotel remain January 27 through January 31.

"Too Good to Miss" is the announced slogan of the S.P.E. meeting and exposition. The show will be open to the public, with certain afternoon hours during the week restricted to the trade. A style show, home utilities show and numerous activated exhibits are being arranged according to J. O. Reinecke of Barnes & Reinecke, Inc., general chairman. Charles L. Jones Chicago industrial designer, is entertainment chairman, while the style show and related activities will be under the direction of the Jo Keith agency.

Some 30 papers by outstanding representatives of the plastics and allied industries will be presented during the technical session according to William L. Hess of the Anesite Co., Chicago, chairman of the meetings committee.

The annual S.P.E. banquet will be Tuesday night, January 28. A nationally known speaker will be featured according to Charles C. Henry, Chicago Die Mold Corp., chairman of speakers committee.

Hotel space of 500 rooms has been secured at the Congress Hotel. Requests for advance reservations should be sent promptly to Daniel Amico, director of sales for the hotel, at 520 S. Michigan Ave., Chicago, Ill. Floor plans and a brochure of information for exhibitors have been issued to prospective exhibitors by W. B. Hoey, 208 Theater Bldg., Birmingham, Mich., S.P.E. executive secretary.

Decision to locate the plant and main offices of the newly organized **Southern Packaging Corp.,** in High Point, N. C., was reached at a directors' meeting in September. Officers are Frank H. Driscoll, president; Harry L. Dalton, vice-president; O. A. Kirkman, secretary and treasurer. The company will be equipped for making highly specialized packages such as bag containers of all types, fancy box covers, metal foil containers, package wraps and labels. It will also laminate fancy gift wrapping materials from aluminum foil, cellophane and paper for consumer use and will make this laminated stock for printers of box wraps such as those widely used by hosiery and other textile manufacturers.

Since the booklet, "Everyday Plastics," was published by Modern Plastics Magazine in 1945, some 20,500 copies have been distributed. Requests have come in from around the world—South Africa, Sweden, Belgium, India, the Philippines, Mexico and South America. More than 200 copies went to the American Educational Service but the bulk of the booklets were ordered by such companies as E. I. du Pont de Nemours & Co., Inc., Dow Chemical Co., A. Bamberger, Taylor Mfg. Co., Celanese Corp. of America, Owens-Corning Fiberglas Corp., B. F. Goodrich Co., Precision Specialities, Cruver Mfg. Co., Waterbury Companies, Inc., as well as a number of plastic molding companies.

Laminating, coating and embossing equipment will process the raw material to supply the stock from which the finished products will be made.

The Protective Coating Resins Div. is the new name of the **Oil Soluble Resin Div. of Durez Plastics & Chemicals, Inc.,** North Tonawanda, N. Y.

The name of the **Technical Sales Div.** has been changed to **Industrial Resins Div.** Announcement was also made of the appointment of J. F. Ortner and M. J. Dubenitz as sales engineers in the Industrial Resins Div. Mr. Ortner's headquarters will be at 250 Park Ave., New York, N. Y., while Mr. Dubenitz' will be at North Tonawanda.

E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., has announced plans for construction of a new unit on its electro-chemicals plant site at Niagara Falls, N. Y., for the manufacture of adiponitrile, one of the main chemical intermediates used in the manufacture of nylon. Work on the project which will cost an estimated $3,000,000 is expected to require 15 months.

A new synthetic, waterproof adhesive more resistant to oxidation than similar natural rubber compounds has been announced by the Fabrics Div. of du Pont. Designated as No. 5118 "Fairprene" adhesive cement, this adhesive is recommended for bonding Buna-N type synthetic rubbers and vinyl films or sheet stocks to rigid surfaces such as steel, aluminum, glass, wood or concrete. A thermoplastic synthetic elastic composition, it does not require vulcanization to obtain maximum strength. It is unaffected by temperatures as low as 40° F. and its adhesive strength is weakened at temperatures of 160° or above.

The Plastics Dept. of **Rohm & Haas Co.,** 222 West Washington Square, Philadelphia 5, Pa., has announced a reduction in the price of Plexene M, modified styrene copolymer molding powder, so cost per lb. of 1 to 499 lbs. of natural is 75¢ that of 1 to 999 lbs. of color is 85¢ per lb. Larger quantities of both natural and colored powder drop proportionally.

The Worcester Moulded Plastics Co. of Worcester, Mass., announces further expansion through the acquisition of a two-story brick building at 10 Hygeia St. The first floor will be used for material storage and the second for manufacturing purposes. This new building will provide an additional 40 percent square feet of space. The Die Shop, Molding and Finishing Depts. will add 150 employees.

The new improved semi-ice proof bottle label machine glue recently introduced by **Paisley Products, Inc.,** 1770 Canalport Ave., Chicago 16, Ill., has been named *Cooler-Proof*. Described as a jelly glue, the glue is reddish brown, odorless and supplied in proper body—making it ready to use in the gum pot. The jelly character of the glue provides a tough, flexible, non-crystallizing glue film that is said to withstand considerable water immersion and resistance to the damp atmosphere of refrigerators and iceboxes.

Reichhold Chemicals, Inc., 601 Woodward Heights Blvd., Detroit 20, Mich., will be producing resins at a new Seattle plant by Jan. 1, 1947, provided reconversion of the million-dollar charcoal plant built by the Chemical Warfare Service in 1942 and acquired by Reichhold in September of this year from the War Assets Corp. proceeds on schedule. First units of the plant will be completed as soon as possible to produce phenolic, urea and melamine resins for the Pacific Northwest's plywood mills. Immediate production is also planned for "wet strength" and coating resins for the paper industry

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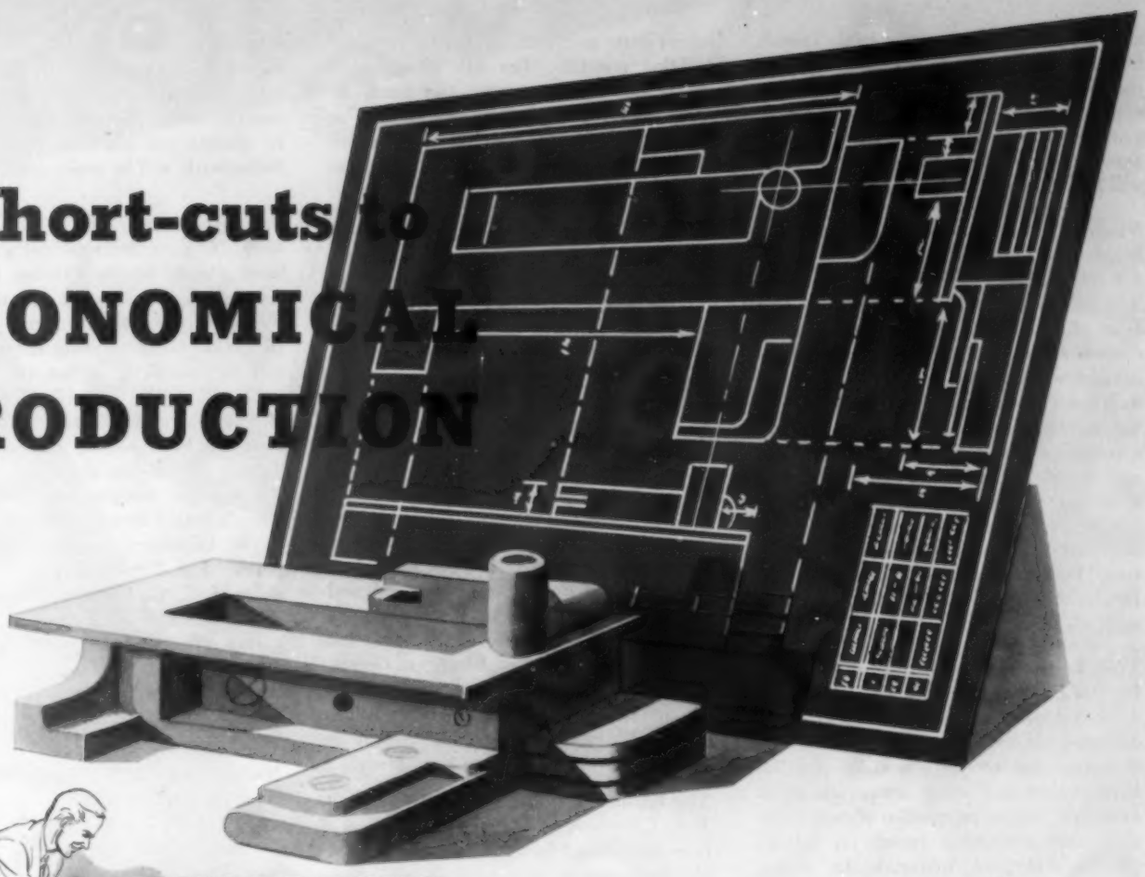

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and impregnating resins used in the manufacture of plastic-faced plywood. Resins used in the formulation of surface coating materials will also be produced. The first year's resin output is expected to be in excess of 25 million pounds. T. S. Hodgins will head the new plant.

Nissley, Inc., custom molders of plastics, began operations on November 1 in a new $20,000 building at Spanish Fork, Utah. The new company plans to turn out any type of fabrication desired, standard or custom molding jobs, engineering, designing and hot stamping service. Machinery includes a 16 oz. hydraulic injection molding machine, an 8 oz. injection molding machine, automatic compressors, grinder and dryer. Officers are: S. B. Nissley, president and general manager; F. M. Taylor, secretary and treasurer; Wallace H. Gardner, chairman of board of directors; Dr. Preston G. Hughes, Dennis L. Prince, W. F. Bowen and Wilmer L. Barnett, directors.

The Industrial Photographic Sales Div. of Eastman Kodak Co., Rochester 4, N. Y., has announced a transfax spray designed for the reproduction of working drawings directly onto metals, plastics, hard rubber and other nonporous sheet materials, for the production of gage faces, dials and instrument panels on metals, plastics and other materials, for wiring diagrams and instruction plates on instrument chassis and cases, for decorating plastic materials. No darkroom is required. There are five steps to the process: priming, coating, printing, clearing and washing, drying and overcoating. It should be used at from 70 to 90° F.

Morningstar, Nicol, Inc., has announced plans for improvement of two buildings purchased for use by a subsidiary, **Paisley Products, Inc.,** in New York City at 622-630 West 51st St. Specially designed mixing equipment and processing kettles are expected to be installed early in 1947. This equipment will give the Paisley adhesive plant an additional capacity of one million pounds per month above their present production.

Marvel Plastic Co., North Olden Ave., Trenton, N. J., has been organized and will manufacture shower curtains, raincoats, baby pants and a simulated leather product from a plastic-type material called Zinyl. A. L. Hersh is president.

The Krieger Color & Chemical Co., 6531 Santa Monica Blvd., Hollywood 38, Calif., announces the development of a new product, Poly Supra concentrate molding powder dyes. These new materials are used to color either clear or opaque molding powders, giving clear and transparent color effect. They can be used with cellulose acetate, polystyrene, Lucite, Plexiglas and vinyl molding powders. Light shades are produced by adding as little as 1/2 oz. of dye to 26 lb. of molding powder. The dye is sprinkled into the molding powder and tumbled, then used in the regular manner. The following colors are available: red, royal blue, blue-green, orange, amber, purple, black and yellow.

Ross & Roberts, Inc., with plant and office at 1131 Campbell Ave., West Haven, Conn., has been formed for the manufacture of plastics products by Arthur M. Ross, Jr., and Alvin V. Roberts. Mr. Ross was formerly with the General Electric Research Laboratory at Schenectady, N. Y., and Mr. Roberts with the General Electric Works Laboratory, in Bridgeport, Conn.

Atlantic Plastics, Inc., of Flushing, L. I., N. Y., has completed its expansion program with the addition of three key executive and three new injection molding presses. William F. Sanford has resigned as assistant treasurer of the New York Trust Co. to devote his full time to the presidency of Atlantic Plastics. George C. W. Oberst is the new treasurer and Carl T. Haugen, chief engineer. In addition, General Manager Joseph E. Benoit is being advanced to the vice-presidency.

The Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11, Ohio, has announced a new disk cement for applying cloth-backed and flexible paper disks to steel disk-grinding machines. This Master Disk Cement, as it is called, is not designed for heavy fiber-backed disks. According to the company, this product has the advantage of being easy to apply and remove.

The American Injection Molders, Inc., Long Island City, N. Y., has been organized and is headed by Alfred Axel. The company's new plant was designed and built with a view to future growth and expansion. It has facilities for designing, engineering, mold making, assembling and for distribution.

Sorry!

In the article on the spray gun, toy flute and water gun appearing on page 123 of the October issue, the tube of the spray gun was inaccurately described as being made of paper. This was in reality a plastic tube, extruded from both Tenite II and from acetate, and supplied by the Carter Products Corp., 6921 Carnegie Ave., Cleveland 3, Ohio. This 1 1/2 in. tube was held to tolerances of 0.002 in. on the inside and outside dimensions in order to fit into the injection molded head.

In the picture of the Kut-N-Serve cake cutter appearing on page 109 of the October issue of Modern Plastics, the cutter was shown with a pie. This cutter, made by Drake Products, Inc., 1412 South Michigan Ave., Chicago 5, Ill., was designed specifically for cutting and lifting of cake.

Sometime this month, the **American Screw Co.,** Providence, R. I., will begin moving to its new modern plant at Willimantic, Conn. The company will continue to operate one plant in Providence but Willimantic will be main output center.

Bakelite Corp., 30 E. 42nd St., New York, N. Y., announces that a license has been granted by the Civilian Production Administration to start construction on the recently acquired property at Ottawa, Ill. This manufacturing building, which will be completed about the middle of 1947, will include 6 bays for the production of Vinylite plastic film and sheeting, and one complete pressing unit for the production of Vinylite plastic rigid sheets.

Personnel designated from Bakelite Corp.'s Bound Brook organization include: A. B. Dickinson, superintendent of the plant; J. A. Burton, assistant superintendent; J. E. C. Valentin, works engineer; W. O. Ackerman, in charge of manufacturing office and J. H. Haynes, head of works laboratory. J. G. Mulcaha is resireident engineer for the corporation.

The Jefferson Chemical Co., Inc., Port Neches, Texas, will manufacture ethylene glycol and ethylene oxide as initial products. This company was organized in November 1944 by the Texas Co. and American Cyanamid Co. to produce chemicals from petroleum and from petroleum gases.

The Detroit Mold Engineering Co., Detroit 12, Mich., has opened a plant in Hillside, N. J. More floor space will be devoted to manufacturing than at the Detroit plant. The machinery will be tooled to make new and larger products not yet on the market.

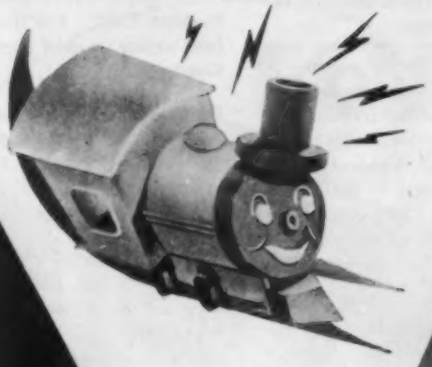
The new **Weizmann Research Center** in Palestine will be composed of four separate units, the **Institute of Plastics Research,** the **Institute of Biology and Pharmacology,** the **Institute of Physics and Physical Chemistry** and the already existing **Daniel Sieff Institute of Chemical Research.** This center will be devoted to the pursuit of pure science.

Personnel Changes

Frank Sanford succeeds **J. J. Keville, Jr.,** as assistant director of sales of the Molding Materials Dept., Plastics Div., Celanese Corp. of America, 180 Madison Ave., New York, N. Y.

Mr. Keville has been appointed director of product application of the Plastics Div. of Celanese. He will head the corps of engineers who evaluate markets for Celanese plastics and study techniques and processes for the fabrication of new products. *(Please turn to next page)*

all 4 toys shown were designed, engineered and injection molded by Universal Plastics Corp



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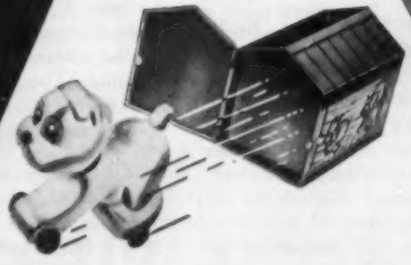

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We regret to announce the death of **Dr. R. Max Goepp, Jr.,** director of organic research, Atlas Powder Co., Wilmington 99, Del., in the air liner crash in Newfoundland on October 3. A nationally known figure in the field of sugar and carbohydrate chemistry, he had been director at Atlas since 1944 and prior to that time had been research chemist with Atlas since 1932. Dr. Goepp returned to this country in August from a trip to Germany where he visited factories and laboratories in the capacity of research expert for the U. S. Government. He was returning to Germany for further study when the crash occurred. He held numerous U. S. patents in the general field of sugar chemistry and was a member of the executive committee which founded the annual review, "Advances in Carbohydrate Chemistry."

Samuel Held, formerly with the Sales Dept. of R. D. Werner Co., has joined the Hopp Press, Inc., 460 West 34th St., New York 1, N. Y., as sales, representative.

Mr. Luber, formerly manager of sales and production development of Lee Plastics, Philadelphia, has accepted a partnership in the Lands Co., Fourth and Walnut Sts., Philadelphia 6, Pa. He will head the sales and design departments.

Walter A. Miller, formerly sales manager of the Products Div., Plastics Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., has been appointed director of sales of that division. He will direct the distribution of all du Pont combs, toothbrushes and such toilet articles with headquarters in the Empire State Building, New York, N. Y.

John A. Buckley, formerly of the General Electric Co.'s Lamp Dept. of Nela Park, Cleveland, Ohio, has been appointed merchandise sales manager for the G-E Chemical Dept. at Pittsfield, Mass.

C. R. Dobson has been elected vice-president in charge of operation of the H. K. Porter Co., Inc., Oliver Bldg., Pittsburgh, Pa. He was formerly chief industrial engineer of the Jones & Laughlin Steel Corporation.

Carleton Ellis, Jr., who has been on active duty as a Navy lieutenant since 1944, has returned to the post of manager, New Products Div., Plaskon Div. of Libbey-Owens-Ford Glass Co. at Toledo, Ohio.

Henry S. Curtis has been named manager of the Glenn L. Martin Co.'s new $1,500,000 chemical plant near Painesville, Ohio. Other appointments include: **Emile W. Milan** as supervisor of production; **Stanley S. Gregory** as plant accountant and office manager of the new plant; **Dr. William J. Lightfoot** as chief engineer of the Plastics and Chemicals Division Construction of the plant, which will manufacture vinyl type resins, is expected to be completed shortly after the first of the year. This marks the entrance into a new field for the Martin Company. The plant will be operated by the Plastics and Chemicals Div. in Baltimore, of which **Robert H. Kittner** is division manager.

R. J. Christ has been elected vice-president and West Coast division manager of the Dobeckmun Co., Cleveland, Ohio. **R. C. Betts** was made vice-president and director of technical development while **T. E. Bruffy** was assigned to the newly created position of West Coast sales manager. **Warren E. Dierking** replaces Mr. Bruffy as Los Angeles sales manager.

William C. Bird, until recently executive vice-president of the Pro-phy-lac-tic Brush Co., has been elected president. He succeeds **John L. Johnston** who has been elected chairman of the board.

Archie Sabin, formerly Price Administrator for plastics raw materials in the OPA, has become chief of the plastics section, Chemical Div., Civilian Production Administration. He succeeds **Wells Martin,** who retired.

Raymond Loewy, Harold Van Doren, Egmont Arens and **Ray Patten** were elected president, vice-president, secretary and treasurer, respectively, of the Society of Industrial Designers at the annual meeting in October.

Robert F. Ohmer has been appointed vice-president in charge of administration at the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Before being called into army service in 1942, he was president of Commonwealth Engineering Co. of Ohio.

John L. Newell has joined the C. M. Smillie Co., Detroit, Mich., manufacturers of tools, gages, fixtures and precision screw machine products, as sales representative in the eastern territory. Headquarters will be in Livingston, N. J.

Maj. Robert Van Tuyle, Col. E. R. Baker and **Don Smith** are three veterans of World War II who have joined Emery Industries, Inc., 4300 Carew Tower, Cincinnati, Ohio. They are director of research on plasticizers, resins and surface coatings, head of the Development Dept. and director of product research for the Candle Div., respectively.

The company has also announced the opening of a new plant for the production of Azelaic and Palargonic acids. The increased production of these acids will be of interest to manufacturers of alkyd-type resins and surface coatings, and those working with vinyls.

George R. Vila, formerly assistant development manager, Naugatuck Chemical Div., United States Rubber Co., 1230 Sixth Ave., New York, N. Y., has been appointed sales manager for latex, Lotol, rubber dispersions and plastic products. He will make his headquarters in Naugatuck, Conn.

Phillip E. Sharr has been named as superintendent of the Pittsburgh Plate Glass Co.'s alkali producing plant at Bartlett, Calif. For the past year he has been acting as chief engineer at the West Coast plant.

Richard E. Booth has been appointed head of the Product Research Section, Van Doren, Nowland & Schladermundt, industrial designers, 220 East 42nd St., New York 17, N. Y.

H. E. Johnson, former director of sales and advertising, Chemical Plastics, Inc., Minneapolis, Minn., has joined the Interlake Chemical Corp., Cleveland 14, Ohio. His work will be with resins and as well as with molding compounds.

Arthur C. Johnson, formerly a lieutenant commander in the Silver Spring Plastics Laboratory of the Bureau of Ordnance, Navy Department, is now in charge of sales in the Boston office of Mica Insulator Company.

Edmund L. Brandon, vice-president of L. V. Armstrong & Co., Inc., a subsidiary of Vargish & Co., 220 Fourth Ave., New York 3, N. Y., has been appointed sales manager of Vargish and is replacing **George V. Nixon.**

Meetings

Amos Ruddock of the Plastics Div., Dow Chemical Co., Midland, Mich., spoke on polystyrenes at the sixth meeting of the plastics for retailers class at New York University's School of Retailing on November 4. Polyvinyl resins was the subject of a talk given by **M. Scott Moulton,** B. F. Goodrich Chemical Co., Cleveland, Ohio, on October 28, while on October 21, **Dr. Marie Bentivoglio,** Celanese Plastics Corp., Div. of Celanese Corp. of America, New York, N. Y., spoke to the class on the history of cellulosic plastics. The course is being sponsored jointly by both the S.P.I. and the New York University.

The Cleveland Section of the Society of Plastics Engineers visited the Plastic Engineering, Inc., 8506 Lade Ave., Cleveland 2, Ohio, November 15.

The Canadian Section of the Society of the Plastics Industry, Inc., met at Toronto on November 13 with **R. H. Cunningham** of the Bryant Electric Co., Bridgeport, Conn., as guest dinner speaker.

The Midwest Chapter of S.P.I. held its fall meeting at French Lick Springs Hotel, French Lick, Ind., on November 7 and 8. Speakers and their subjects included:

DENISON HydrOILic

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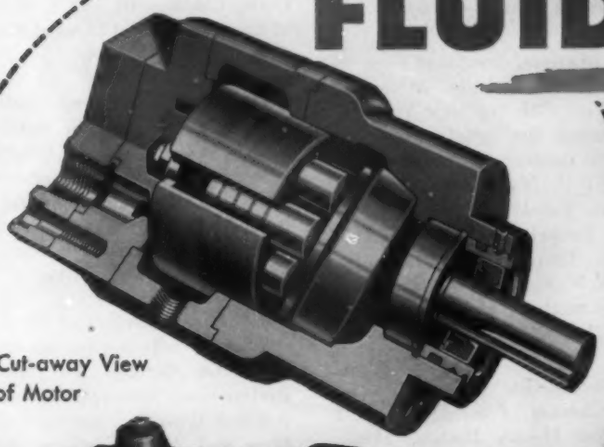

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Quick speed-up for rapid-traverse needs is provided by a plunger device interlocked with the speed-control valve. It permits instant acceleration from any pre-set speed to full-speed operation, for any desired interval. Releasing the plunger causes the motor to resume its pre-set speed.

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Dr. M. H. Bigelow, director of technical service, Plaskon Div., Libbey-Owens-Ford Glass Co., on "German plastics"; **Chester M. Robbins,** vice-president of Aridye Corp., subsidiary of Interchemical Corp., on "Printing on vinyl film"; **C. A. Lydecker,** president, Peerless Roll Leaf Co., Inc., on "Roll leaf stamping on plastics"; **E. B. Yelton,** Technical Service Dept., E. I. du Pont de Nemours & Co., Inc., on "Teflon"; **Frank H. Carman,** general manager, Plastic Materials Manufacturers Association, "Review of plastic materials supply outlook."

The American Society for Testing Materials has announced the dates for its national meeting in 1947. The spring meeting and committee week will be held at Benjamin Franklin Hotel, Philadelphia, Pa., February 24 to 28, while the fiftieth annual meeting will be at Chalfonte-Haddon Hall, Atlantic City, N. J., June 16 to 20.

A symposium on testing and evaluation of paints and paint materials, under the joint sponsorship of the society's Committee D-1 on paint, varnish, lacquer and related products, and the A.S.T.M. Philadelphia District, will be the technical feature at the Philadelphia meet. The important highlights of the Atlantic City meeting are to be announced at some later date.

A Standards and Specifications Committee headed by **Paul Hofmann** was formed at a meeting of the Low Pressure Industry Division Committee at Detroit on October 4. This committee will establish, gather and compile existing technical data for the purpose of standardizing materials, methods as well as procedures for the entire low-pressure industry.

The Chicago Section of S.P.E. met at the Merchants and Manufacturers Club, Merchandise Mart in Chicago, Ill., on November 5. **George Sollenberger** of Rohm & Haas Co., 222 West Washington Square, Philadelphia 5, Pa., discussed Plexene, a styrene copolymer.

Dr. Charles Marleis, director of research and development for the Metaplast Corp., 205 West 19th St., New York 11, N. Y., discussed the metal coating of plastics at a meeting of the Newark Section of S.P.E. November 13 at the Military Park Hotel in Newark, N. J. **Walter A. Toepel,** field engineer for Parker-Kalon Corp., 200 Varick St., New York 14, N. Y., talked on the subject of "Assembly methods and fastenings of plastic parts."

A committee meeting of the Boston-Providence Chapter of S.P.I. was held at the Parker House, Boston, Mass., October 31. Future meetings were set tentatively for the first or second week in December and for February, April, June and September of this coming year.

The Society of the Plastics Industry has named **Allan Fritzsch** of the General Industries Co., Elyria, Ohio, chairman of the committee to direct the second National Plastics Exposition in Chicago May 5 to 11. Committeemen are: **R. E. Blanchard,** Stimson AGA Plastics, Chicago, Ill.; **Allan Brown,** Bakelite Corp., New York, N. Y.; **Charles F. Elmes,** Elmes Engineering Works, Chicago, Ill.; **J. R. Hoover,** B. F. Goodrich Chemical Co., Cleveland, Ohio; **J. L. Howie, Jr.,** Grigoleit Co., Chicago, Ill.; **Elmer E. Mills,** Elmer E. Mills Corp., Chicago, Ill.; **Edward J. Pechin,** E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.; **J. W. Stokes,** Chicago Molded Products Corp., Chicago, Ill. and **J. R. Turnbull** of the Monsanto Chemical Co., Springfield, Mass.

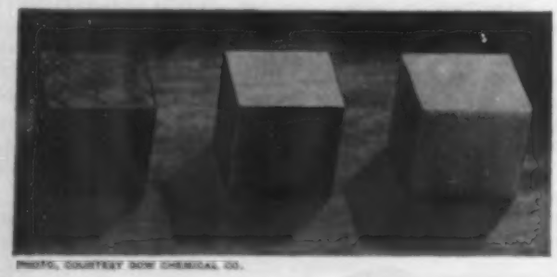
The Detroit Rubber and Plastics Group, Inc., conducted its fall meeting at the Detroit Leland Hotel, Detroit, Mich., October 18. Physical properties and molecular structure of natural and synthetic rubbers were discussed by **Dr. Arthur V. Tabolsky,** professor of chemistry, Princeton University.

The St. Louis Section of the S.P.E. held its second fall meeting at the DeSoto Hotel on October 14. **Dr. J. W. Richardson,** technical representative of Rohm & Haas Co., discussed the applications and misapplications of Plexiglas, particularly in the use of this material in sheet stock.

S.P.E. and A.S.T.E. held a joint meeting at Hotel Allerton, Cleveland, Ohio, on October 18. **Russell R. Bradshaw** and **Gordon B. Thayer** of the Dow Chemical Co., Midland, Mich., discussed the value of mold design in efficient plastics production. A movie, "The shape of things to come," put out by the Boonton Molding Co., was also shown.

STYROFOAM,[1] AN EXPANDED POLYstyrene originally announced almost 2 years ago, has been improved and tailored to serve as a low-temperature insulation. The material is Styron expanded forty times. This expansion produces a pure white, lightweight, multicellular mass of foam-like material with low thermal conductivity, good structural strength, and, what is important in thermal insulation, an uncanny ability to resist moisture and water. The material is tasteless, odorless and has good resistance to mold and rot. Atmospheric exposure does not affect it adversely and it does not lose its strength at low temperatures. Also, it shows no tendency to disintegrate or settle—an important factor in all low-temperature insulation.

[1] Product of the Dow Chemical Co., Midland, Mich.



PHOTO, COURTESY DOW CHEMICAL CO.

Three 2 in. cubes—cork (left) weighs 19½ g., balsa, (center) 22 g. and expanded polystyrene, 3 6/10 grams

The physical structure of the expanded polystyrene consists of a mass of small "walled" or sealed cells and it is the continuous wall of the individual cells which prevents water permeation and freezing within the structure. Many insulations absorb moisture and their actual insulation efficiency is considerably less after a period of time than the theoretical efficiency at time of installation. Styrofoam, however does not absorb moisture, maintains its efficiency throughout use.

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PHOTOS, COURTESY INDUSTRIAL SYNTHETICS CORP.

1—Shoe trim and shoes of open-work design are popular applications for flat and round strips of extruded vinyl

2—Keeping belts spruce and clean is no problem when made of extruded vinyl which cleans with a damp cloth

Uses for extruded vinyl

THE VERSATILITY that is plastics' is not confined to molded and fabricated items. It's characteristic of the extruded materials as well. Take for example the three illustrations, appearing on this page, of uses for Elastron,[1] a polyvinyl-type plastic material.

[1] Product of Industrial Synthetics Corp., Irvington, N. J.

3—Since it can be sterilized, extruded vinyl is a natural for applications that must be free of all contamination

In the bows and straps in Figs. 1, the full flexibility of the material is put to use as well as its range of colors; resistance to wear, exposure and perspiration; and the fact that it will not crack, scuff and peel. Figure 2 with its women's belts shows uses for the high glossy patent finish, the smooth dull surface and the grained effects possible in extruded vinyl. And the carriage strap in Fig. 3 has the highly important quality of resistance to sterilization and ability to be cleaned with a damp cloth. The non-flammable characteristic of this material also makes it most acceptable in this last type of application.

This material, which can be extruded in widths up to 12 in. in a variety of thicknesses and profiles, can also be made in tubular form ranging from 0.021 to 2.5 in. in diameter. And it can be so compounded as to meet specific requirements of the user.

Test results

Available in opaque, translucent or transparent colors, this polyvinyl-type material has a tensile strength of about 2000 p.s.i. and it is not noticeably affected at temperatures up to 180° F. It has been found that if a sample is kept in an oven at 212° F. for a period of 72 hr., then removed and tested after a rest period of 16 to 20 hr. at room temperature, its tensile strength and elongation show only 5 percent change.

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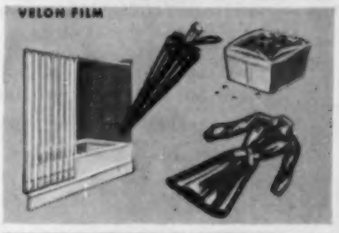

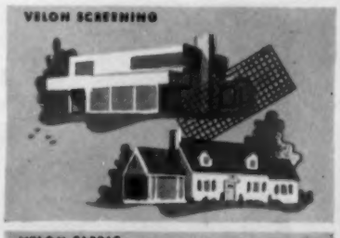

Oxygen in polymerization

(*Continued from page 162*) styrene and butadiene. To arrive at an exact explanation of the influence of oxygen on emulsion polymerization, the following tests were made:

1. Atmospheric oxygen was excluded by flushing the reaction vessel with highly purified nitrogen.

2. Flushing with nitrogen was followed by addition of a mixture of a reducing agent, such as sodium thiosulfate, hydrazine sulfate, or hydroxylamine hydrochloride, and a percompound as activator.

3. Flushing with nitrogen was followed by a preliminary reducing treatment of the reaction mixture by addition of one of the previously mentioned reducing agents and then (possibly gradually) by addition of the percompound used as activator.

Batches were prepared according to the third method with Amphoseife 18, Mepasin sulfonate and paraffinic fatty acids as emulsifying agents. With the exception of butadiene, which is relatively nonreactive at the very low temperature of 20 to 25° C., the emulsion polymerization experiments could be carried out at room temperature. The polymerization reaction started at once, sometimes with a marked temperature rise which required augmented cooling. The induction period was not observed in any case. Polymerization times were extremely short; 80 to 85 percent yields of polymer were obtained at 20° C. in the following times:

Vinyl compound	*Polymerization time*
	hr.
Vinyl chloride	4
Vinyl acetate	6
Acrylic esters	6
Styrene	12

Table III.—Heats of Combustion and Polymerization of Vinyl Compounds

Product	*Heat of combustion*		*Heat of polymerization*	
	Monomer	*Polymer*		
	Cal./g.	*Cal./g.*	*Cal./g.*	*Cal./mol*
Vinyl acetate[a]	5.786	5.458	0.328	28.00
Acrylic acid[a]	4.520	4.311	0.209	15.00
Styrene[a]	10.041	9.831	0.210	21.90
Butadiene	11.314	10.788	0.526	28.45
Butadiene	11.165[b]	10.773[c]	0.392	26.70

[a] Staudinger and Schlaeper (See Houwink, "Chemie und Technologie der Kunststoffe," 1939, p. 79).
[b] W. Lebedew and M. A. Chochlowskin: J. prikle. Chimi 1605–12. The heat of combustion of isoprene is 11.172 Cal./g. according to investigation of Dr. Neukirch, Oppau Ammonia Laboratory, I. G. Farbenindustrie A.-G.
[c] Heat of combustion of natural rubber. On the basis of Dr. Neukirch's investigation, the heat of combustion of an isoprene polymer obtained by heat polymerization is 10.666 Cal./g.

In order to get a quantitative polymerization reaction, the emulsions were subsequently heated for several hours at 40° C.

The K-values of the polymerization products obtained according to this new improved method were generally lower than normal. This was confirmed by experiments made by Fikentscher and Herrle.[55] The decrease in K-values can be prevented by changing the polymerization conditions; polymers with the K-values specified for various end uses can be obtained.

The following individual experiments are cited as examples:

1. Polyvinyl chloride
   2875 cc. water
   27 g. Mepasin sulfonate (salt free)[56]
   3.75 g. sodium thiosulfate

The mixture was shaken for 30 min. at room temperature after air was removed by flushing the reaction vessel with pure nitrogen. Then 6 g. potassium persulfate

THE GROWING OPINION AMONG leaders in the plastics industry that a sounder future public appreciation of plastics and a better public knowledge of plastics materials can be best obtained through present promotion in the juvenile field, is implemented by an innovation which is called the Plasto-Magic Set.

The set, manufactured by Plastomic Products Co., Inc., of New York City, offers magic tricks and experiments in plastics, along the same lines that chemical sets offer to the chemical field. By featuring magic, the set takes the mystery out of plastics, giving the youngster a grounding in the practical aspects of the materials.

The kit is in the form of a large book, colorfully illustrated. In its 28 pages appear the printed directions for executing the tricks, descriptions of the materials and a wide variety of the solid plastics themselves. Working materials mounted in the book include polystyrene, polyvinyl alcohol, acrylic, polyethylene, neoprene, nylon, acetate, vinyl and other thermosetting plastics. At the back of the book are bottles of resin and accessories held in cushion pockets.

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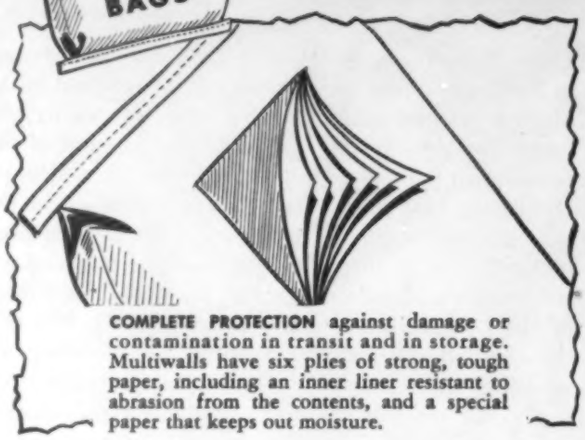
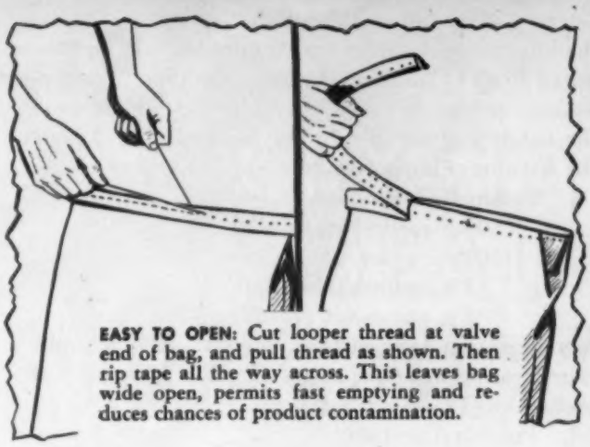
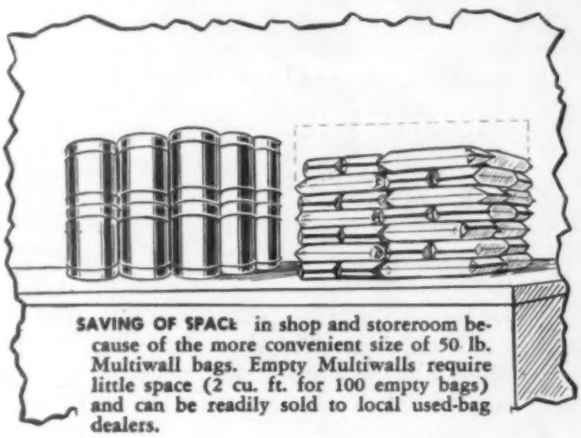


COMPLETE PROTECTION against damage or contamination in transit and in storage. Multiwalls have six plies of strong, tough paper, including an inner liner resistant to abrasion from the contents, and a special paper that keeps out moisture.



EASY TO OPEN: Cut looper thread at valve end of bag, and pull thread as shown. Then rip tape all the way across. This leaves bag wide open, permits fast emptying and reduces chances of product contamination.



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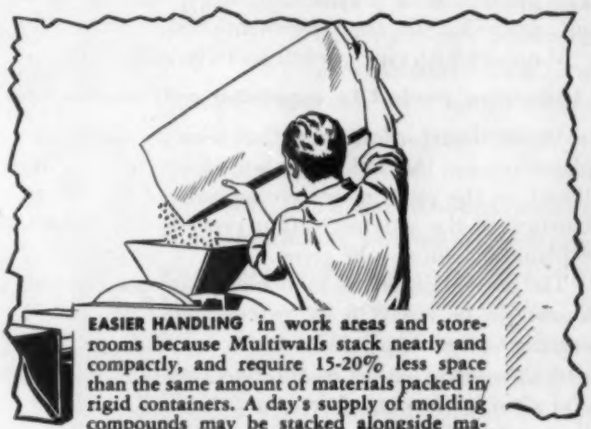

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was added and 1 liter (925 g.) vinyl chloride was introduced under pressure. After 4 hr. shaking at 20 to 25° C. there was no pressure in the reactor. The polyvinyl chloride had a K-value of 72.

2. Polystyrene.

500 g. styrene
5 g. paraffinic fatty acid (Oppau PFS 14)
800 cc. water
100 cc. sodium hydroxide (4 percent)
1 g. sodium thiosulfate

The mixture was stirred for 20 minutes. It was then heated to 40° C. and a solution containing 2 g. of potassium persulfate was gradually added dropwise. The batch was completely polymerized after 3 hours. The K-value of the polystyrene was 153.

3. Polymethyl acrylate

500 g. methyl acrylate
1500 cc. water
1 g. sodium thiosulfate
2 g. potassium persulfate

Polymerization temperature was 25° C. and subsequent heating was done at 40° C. The K-value of the product was 125.

4. Polyvinyl acetate

The product of a polymerization experiment carried out according to the aforementioned.

Method 3 with vinyl acetate had a K-value of 115.

Induction period in emulsion polymerization

As mentioned before, there has been no plausible explanation for the induction period up to this time. Based on the more recent conceptions of the reaction kinetics of the polymerization process, the following explanation can now be given.

The activation of the monomeric vinyl compound is known to be initiated by percompounds. These inorganic or organic peroxides which are used as catalysts add themselves either to the unsaturated compounds and yield by decomposition the activated molecules or they split off atomic oxygen directly which then initiates the activation. These decomposition processes are promoted by:

1. Water or aqueous dispersion agents, but especially conditional upon the hydrogen ion concentration of the aqueous phase.
2. Additional agents which especially accelerate the decomposition of peroxides, such as ferrous salts,[57] complex heavy metal salts[58] or enzymes.[59]
3. Heat.

From the activator, added in a definite amount, there gradually splits off a definite amount of atomic oxygen which then activates the monomer molecules. When atmospheric oxygen is present, the previously activated molecules are deactivated and thus prevented from starting the second stage of the chain reaction, propagation. Only after all of the atmospheric oxygen has been used up can the polymerization reaction start. Since one mol of the original monomer is activated by 16 g. of atomic oxygen, and the thereby activated molecules of the vinyl compound are deactivated by 32 g. of molecular oxygen, the time of the onset of polymerization is determined by the ratio of atomic oxygen to molecular oxygen present in the reaction vessel. The speed of the activating and deactivating reactions must also be taken into consideration. The onset of the polymerization reaction will occur when the amount of atomic oxygen, formed by decomposition of the peroxide, is larger than half the amount of molecular oxygen available for reaction at the same time.

Decreased K-value in polymerization

The following explanation is given for the decrease in K-values of polymerization products obtained in the absence of atmospheric oxygen. The atomic oxygen formed by decomposition of a definite amount of the percompound used as activator activates a definite number of molecules of the monomer. Since in the presence of atmospheric oxygen a part of these activated molecules are in turn deactivated, the number of activated molecules decreases and the molecular weight of the polymerization product increases. But if this deactivation process is eliminated by excluding atmospheric oxygen according to the previously described methods, the number of molecules active as polymerization nuclei increases considerably and the molecular weight or K-value will consequently be proportionately lower. On the basis of earlier investigations, the decrease in K-value can be prevented by:

1. Increase in emulsifier concentration.
2. Decrease in the amount of activator.
3. Decrease in polymerization temperature.

Thus, it is possible to obtain with this new improved emulsion polymerization method products which will have the same K-value as the present industrial polymerization products.

The great advantage of the new improved emulsion method is the elimination of a hitherto overlooked factor which has an important effect on the course of polymerization, namely, atmospheric oxygen which acted as a deactivator during polymerization and was uncontrolled. The emulsion polymerization of styrene will serve to clarify this further. Let us assume that we want to produce a polystyrene with an average molecular weight of 300,000, i.e., of polymerization degree 3000. It is easy to see that 1 mol (104 g.) of activated styrene uses 2999 mols (ca. 300 kg.) of styrene to form the high molecular weight polymer. The composition used for the production of this polymer is as follows:

300 kg. styrene	= 338 liters
3 kg. PFS	
0.600 kg. potassium persulfate	
1.2 kg. sodium hydroxide (100 percent)	
595.2 kg. water	
600 kg. aqueous phase	= 600 liters
	938 liters of emulsion

A stirring vessel of 1250 liter capacity is necessary for this experiment, in order to leave enough space for about 300 liters of air after the mixture is added to the vessel. The temperature of the air is 20° C., the air pressure 760 mm. The volume of the air reduced to 0° C. and

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760 mm. is 280 liters. The weight of this amount of air is 364 g. (280 × 1.2928). These 280 liters of air contain 58.5 liters of oxygen (83.5 g.) which might be able—in case they are mixed into the emulsion—to deactivate the styrene activated by the decomposition of the potassium persulfate.

But the content of dissolved oxygen in the aqueous phase must also be considered. In the approximately 600 liters of water 3.816 liters (6 × 0.636) of oxygen are dissolved at 20° C. The weight of these 3.816 liters of oxygen is 5.44 g. (1.42895 × 3.816).

Assuming that a closed vessel is used, there are under the given experimental conditions 88.94 g. of molecular oxygen present which might deactivate the activated styrene molecules. To activate 1 mol of styrene (104 g.), only 16 g. of atomic oxygen are required. These 16 g. of atomic oxygen are provided by the decomposition of 1 mol of potassium persulfate.

$$\underset{270}{K_2S_2O_8} + \underset{18}{H_2O} \longrightarrow \underset{2\times 136}{2KHSO_4} + \underset{16}{O}$$

But according to the aforementioned directions, 600 g. of potassium persulfate are added to activate the polymerization; this will yield 35.6 g. of active atomic oxygen. Thus, because of the 88.94 g. of molecular oxygen present which partially deactivate the activated styrene molecules—without considering any other secondary reactions such as oxidation—it has become necessary to increase the amount of activator by 2.2 times to carry out the polymerization. But increasing the amount of peroxide is totally unwanted because, according to the aforementioned experiments by Staudinger and Schulz, the added amount of activator will increase considerably the degree of branching of the polystyrene.

The bearing which this has on the emulsion polymerization of butadiene in which both cross-linking and branching are involved, is not yet completely clear. In our latest tests it has been possible to produce, a still soluble butadiene polymer at 40 percent conversion.

Vinyl compounds (styrene, acrylic esters, butadiene) must be stored as airtightly as possible to prevent formation of moloxides from reaction of the vinyl compound with atmospheric oxygen. Since water and alkaline liquids promote the decomposition of the moloxides which may be formed, it is also necessary to store the products dry. As shown in the foregoing example of an emulsion polymerization of styrene, extraordinarily small amounts of atomic oxygen cause the initiation of a polymerization reaction. Since higher temperatures during storage will possibly cause decomposition of moloxides, the storage tanks must be cool. This is the more important because considerable heat is liberated by auto-polymerization (Table III).

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Thermal expansion

(*Continued from page 157*) could not be removed from several other panels, having compositions closer to that calculated, without tearing the metal, shearing the metal at the bond or rupturing the core.

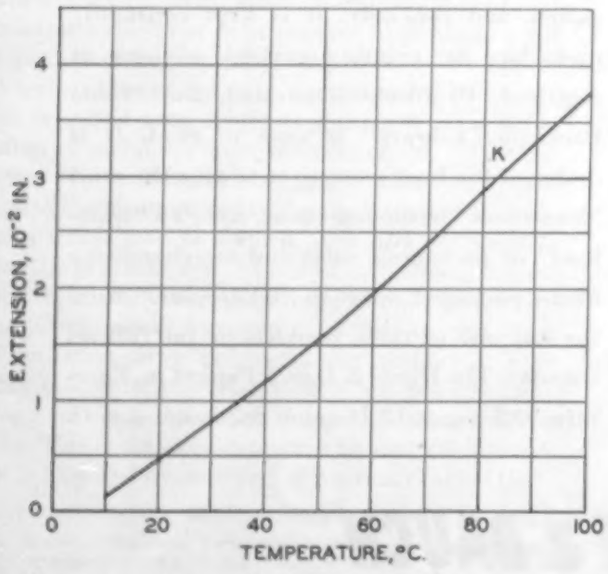
Representative measurements of thermal-expansion coefficients of plastic materials for various temperature ranges are presented in Table III.

A typical thermal-expansion curve for pure molded phenolic resin (Durez 120) is shown in Fig. 5. Carbon black is often added to plastic compositions as a filler. It is therefore interesting to note that addition of 10 percent of a channel type of carbon black to phenol-formaldehyde resin reduced the thermal coefficient of the mixture approximately 20 percent (see Table III). From published values for the density and thermal-expansion coefficient of carbon black together with the measured properties of the pure phenolic resin, a value for the bulk modulus of carbon black was calculated to be approximately 3×10^6 p.s.i.

Lignin resin has been used in a number of applications in conjunction with phenolic resins. Two effects are to be noted: first, that the product does not become stable until it has been heated a considerable length of time beyond the time required to cure the phenolic resins; and second, that the lignin initially increases the coefficient of the mixture, but after heating finally decreases it by a small amount.

The effect of the walnut shell flour is similar to that of the lignin resin. The manufacturers of this material state that it contains a large proportion of lignin. One of the uses of this material is as an extender for plywood adhesives.

The behavior of filled phenol-formaldehyde resin



5—Thermal-expansion curve for pure molded phenolic resin. (Original length of specimen at room temperature: 7.05 in.)

Table III.—Measured Coefficients of Linear Thermal-Expansion for Various Plastics

Material[a]	*Range*	*Linear thermal-expansion coefficient*
	° C.	10^{-6}/° C.
Pure phenolic resin (Durez No. 120)	20–100	58.5–58.9
	20–50	49.7
	20–30	50.2
Durez No. 120, 10% Micronex (channel-type carbon black)	20–100	44.9–47.4
Durez No. 120, 41% aluminum oxide	20–50	34.7
Durez No. 120, 10% lignin resin		
First heating	20–53	47.9
	53–100	78.8
	20–100	62.8
Second heating	20–100	54.7
	20–100	54.1
Third heating	20–53	47.2
	53–100	59.9
Durez No. 120, 10% walnut shell flour filler		
First heating	20–49	43.8
	49–100	68.0
	20–100	59.2
Second heating	20–49	45.7
	49–100	58.8
	20–100	54.1
Glass Mat 25%, Bakelite XC-11749 phenolic resin 71%, starch 4%		
First heating	20–65	29.9
Third heating	20–65	29.3
Glass Mat 28%, Bakelite XC-11749 68%, starch 4%	20–70	26.0
Glass Cloth 44%, Durez No. 120 39%, starch 17%	20–70	17.8
Columbia resin No. 39		
First heating	10–50	103.3
Second heating	20–50	105.8
Second heating	20–100	124.7
Methyl methacrylate resin	20–50	71.5
Pregwood, parallel-ply maple,[b] low resin content		
Parallel to grain	20–50	4.7
Perpendicular to grain	20–50	63.5
Pregwood, parallel-ply maple, high resin content		
Parallel to grain	20–50	5.9
Perpendicular to grain	20–50	68.7
Pregwood, 7-ply maple, plies alternately crossed, low resin content		
Four-ply direction	20–50	13.5
Three-ply direction	20–50	19.8
Pregwood, 7-ply maple, plies alternately crossed, high resin content		
Four-ply direction	20–50	16.7
Three-ply direction	20–50	21.0
8-ply 0.01 inch-thick birch, symmetrical cross-ply construction, 39.5% Amberlite PR-14	20–30	15.4

[a] Percentage figures are based on the weight of the total composition.
[b] These Pregwood materials were erroneously reported to have been prepared with birch veneers in the N.A.C.A. advance restricted report of July 1941, entitled "Properties of reinforced plastics and plastic plywoods."

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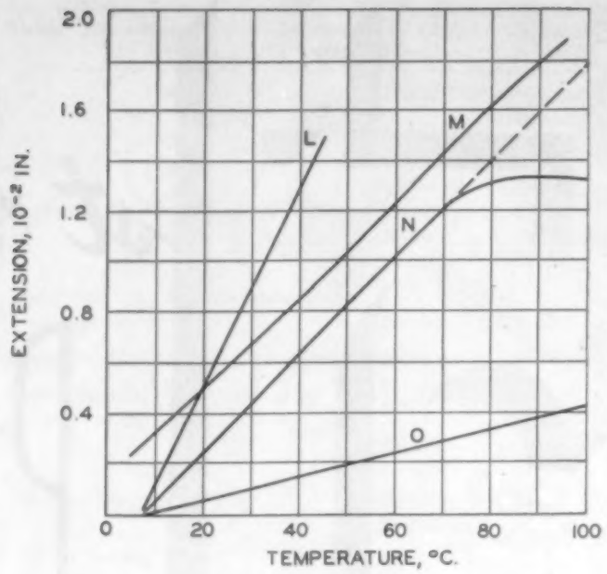

6—Thermal-expansion curves for phenolic resin and glass fiber mixtures. (Original length at 25° C.: 6.57 in.; final length at 25° C.; 6.54 in.). Curve L: pure phenolic resin. Curve M: filled phenolic, third heating. Curve N: filled phenolic, first heating. Curve O: glass mat (the manufacturer's data)

containing 25 percent of glass fiber, 71 percent of phenolic resin and 4 percent of starch is illustrated by the curves for mixtures of glass fibers and phenolic resin shown in Fig. 6. Curves *L* and *O* are for pure phenol-formaldehyde resin and glass fibers, respectively. Curve *N* was obtained on the first heating cycle. The form of the curve above 70° C. is affected by plastic flow, relief of molding strains and further curing of the resin.

The shrinkage indicated at 100° C. on curve *N* took place over a period of 5 hr., during which time the temperature was maintained constant. The rate of shrinkage was initially rapid but reached a steady value after about 4 hours. After cooling the sample slowly and then reheating to 100° C., the same steady rate of shrinkage was resumed for 4 more hours, after which the specimen was slowly cooled to room temperature. The total shrinkage amounted to 0.5 percent. Curve *M* of Fig. 6 is the thermal-expansion curve for this annealed specimen.

The transparent materials for which data are given in Table III have been used or proposed for use as airplane windshields. The temperature-extension curves in each case varied from a smooth curve on the first heating cycle between 50° and 100° C. The curve for the Columbia Resin 39 sample (Fig. 7, curve *P*) showed a decrease in expansion in this range followed by a resumption of the upward trend. No such break occurred in the cooling curve (Fig. 7, curve *Q*) or in the curve obtained when the sample was heated a second time (Fig. 7, curve *R*), although the temperature was raised above 110° C. The sample was per-

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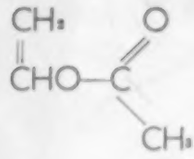

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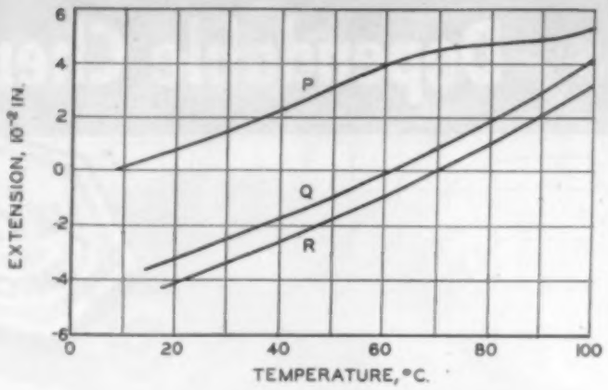
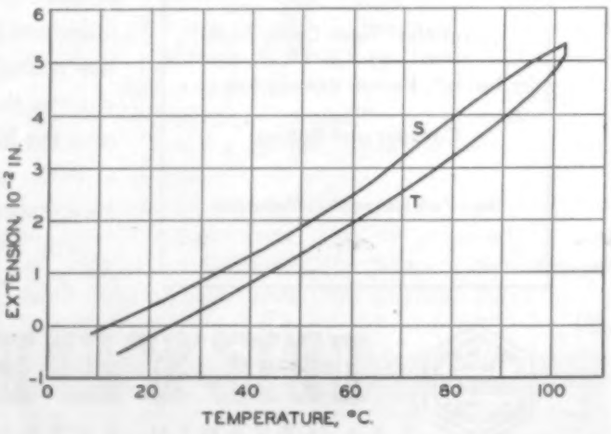


7—Thermal-expansion curves for an allyl resin (Original length at room temperature: 7.48 in.). Curve P: first heating. Curve Q: first cooling. Curve R: second heating

manently shortened during the first heating to the extent of 0.5 percent. The specimen at the same time increased in thickness.

The curve for methyl methacrylate resin (Fig. 8, curve *S*) for the range 50° to 100° C. showed an increase in expansion followed by a decrease. Again the break did not occur in the cooling curve (Fig. 8, curve *T*). The changes were too small to be measured significantly with a steel scale so a check was run on smaller specimens which were heated in an oven at 80° C. for 18 hours. The indicated change was verified by an increase in dimensions in the plane of the sheet and a decrease in thickness. This is in agreement with observed dimensional changes on aging. Methyl methacrylate resin is one of the best available materials from the standpoint of freedom from crazing, unless subjected to strain and dimensional stability. The surfaces of both the methacrylate and the allyl materials appeared to be unaffected by the treatment.

The implications of the concept and methods of analysis touched briefly in the preceding pages are too



8—Thermal-expansion curves for cast methacrylate resin. (Original length at 25° C: 7.04 in.). Curve S: heating. Curve T: cooling

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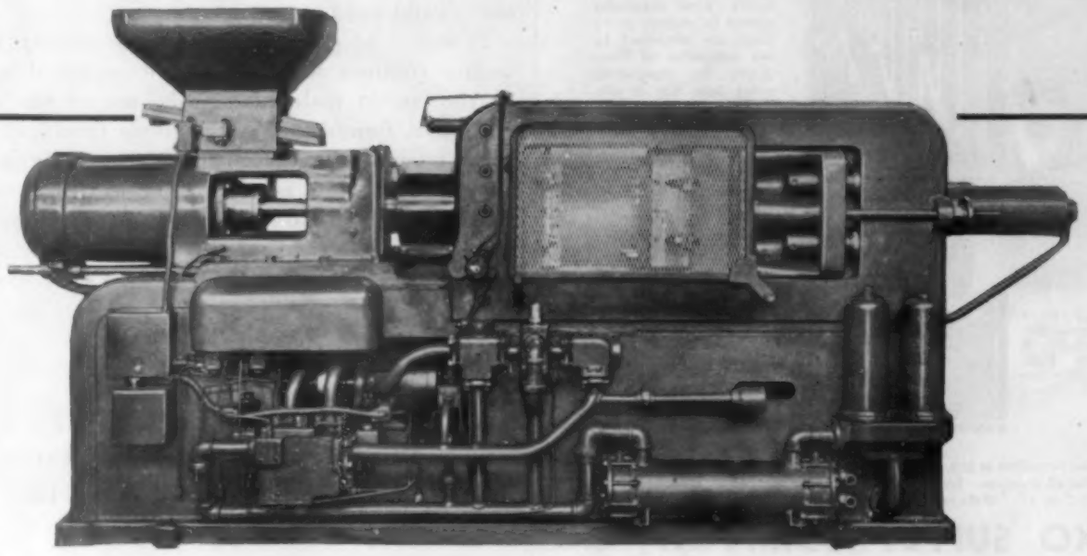

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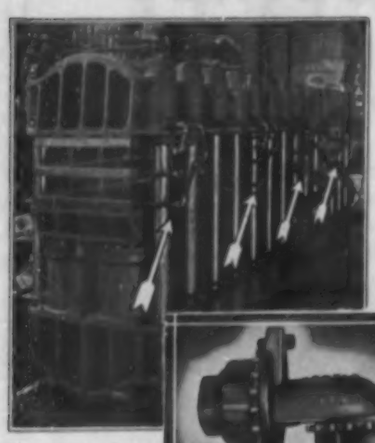

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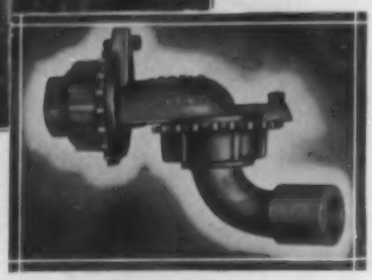

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numerous to be adequately treated in so short a space. Special applications have already been mentioned.

Since the magnitude of the stresses distributed throughout the mixture are proportional to the size of the elements, the ultimate strength of the material and its fatigue limits should be raised by reducing particle size. Specifically, the strength of plywood should be increased by the use of thin veneers. At the temperature of fabrication the effect of particle size should reach a minimum.

It should be possible to formulate pigmented protective coatings which will have improved adhesion to the coated materials by the use of the thermal coefficient formula. The equations described in this paper offer a rapid and reliable means of obtaining the basic physical data needed for use in the calculations. With such information the combination of materials can be figured to yield a film matching the base material with respect to coefficient of thermal expansion.

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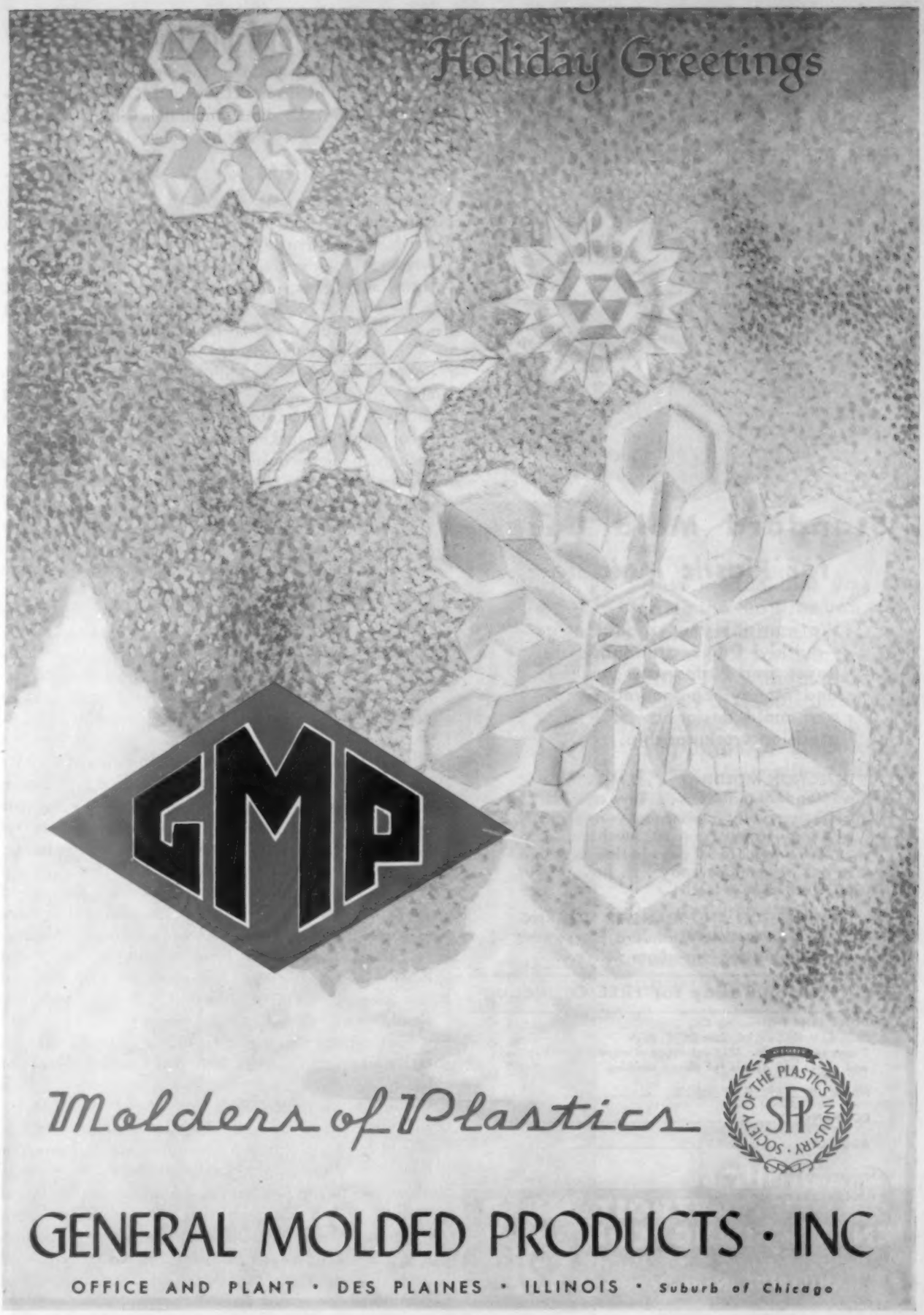
F. E. Reinhold Co., 7001 McKinley Ave., Los Angeles, Calif.
Rochelle Gifts, 481 Main St., New Rochelle, N. Y.
Sentinel Radio Corp., 2100 W. Dempster St., Evanston, Ill.
Service Plastics, Inc., 1120 W. Jackson St., Chicago, Ill.
Sun Glo Studios, 225 5th Ave., New York, N. Y.
Superedge Products, Inc., Commerce Bldg., Erie, Pa.
Tippecanoe Novelty Corp., P. O. Box 447, Lafayette, Ind.
Unique Plastics Corp., 3147 Fulerton Ave., Chicago, Ill.
Warner-Wright Inc., Pawlet, Vt.
Wayne Plastic Products, Fort Wayne, Ind.
T. J. White Plastics Co., 9977 Manchester St., St. Louis, Mo.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The public and plastics

(*Continued from page 5*) in their pocket is fast nearing its end. Furthermore the period of shortages in rubber, metals, wood and other materials will soon be over.

What then if plastics is remembered only as a substitute?

The industry simply cannot ignore this "ersatz" charge with smug indifference. It is only one of many criticisms that will be leveled at the industry in the tough, competitive days now on the horizon. A public relations program that informs the public and keeps them informed is sorely needed by this industry. It is the obvious answer to counteract the untruths and misunderstandings left on the plastics doorstep.

The logical center for such public relations is in the Society of the Plastics Industry where it now rests—and "rests" is a good word for it. Practically all efforts of the Public Relations Committee as such have been puny, isolated, spasmodic and devoted almost entirely to microscopic affairs. The industry's one big splurge, the 1946 Exposition, was handled by a special committee with the Public Relations Committee virtually limited to a position as onlooker. This is no criticism of the membership of that committee, but it is a criticism of S.P.I. as a whole for failure to recognize that the public is woefully ignorant of the truth about plastics; that a Public Relations Committee should be invested with authority to spend thousands of dollars on a sustained program with no let up; that funds allocated for a few booklets and press releases twice or thrice a year is equivalent to an attempt to make Lake Michigan saline by pouring in a bucket of salt.

Public relations is a continuous job. It requires money, manpower and long range vision. Today's worry over "ersatz" is nothing compared to future problems over such things as competition with light metals, rubber and fibers. The public needs to be relieved of its bewilderment with plastics nomenclature. The importance of informative labeling has not even been sold to the plastics industry itself. The veil of mysteriousness with which some operators have attempted to cloak the industry is a hindrance to progress—the public wants mystery only in books and movies. It is time that consumers are told why and how plastics will serve them in the home. And they should be told every day—not once a year.

Furthermore the telling should be done by authoritative sources who speak from real knowledge and not left to superficial, part-time experts whose twaddle fills the air and the printed page today.

In short, it seems to us that the members of S.P.I. should insist that their Association devote as much or more time and money to public relations than it has so ably done to the fields of labor relations and technical manuals. Technical perfection will mean little if what is produced cannot be sold. An aggressive, hard charging, far-seeing public relations committee with full authority and sufficient funds to do a constructive and continuous job is essential.

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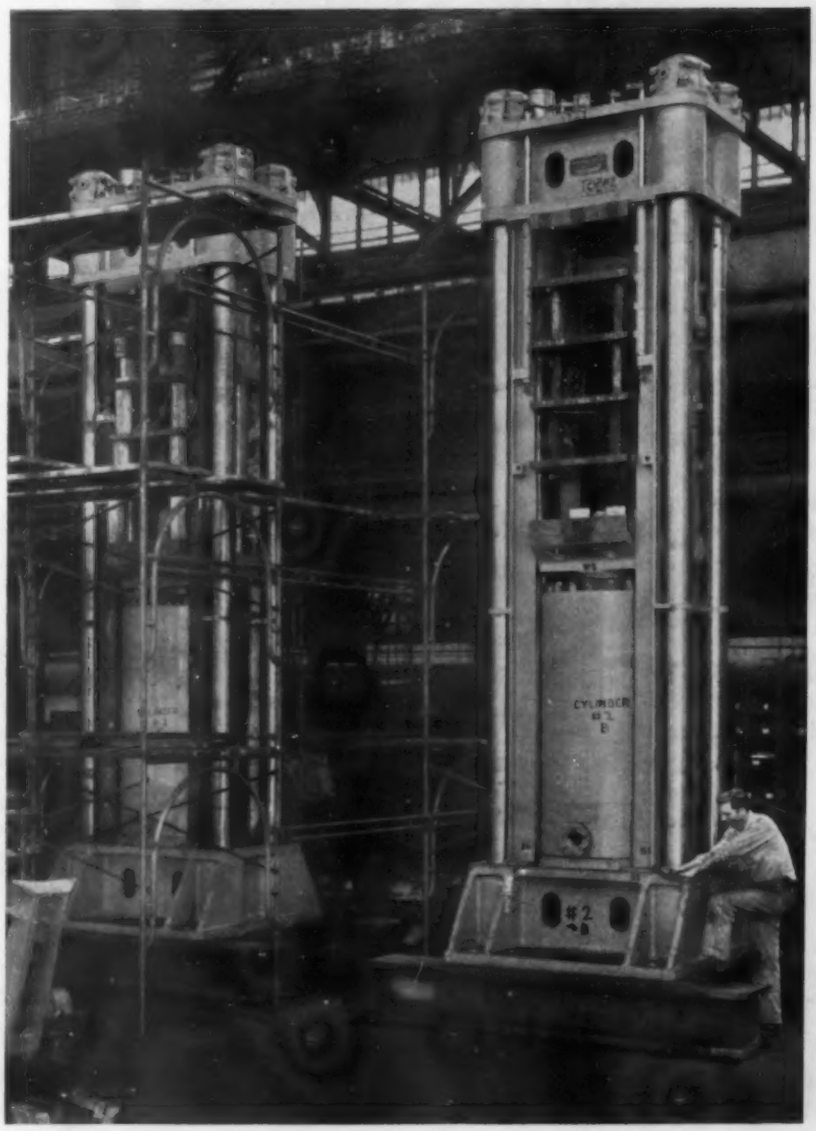
Two 1285-ton presses under construction in the Bethlehem shops



This means that you can name the features you want —and get them.

We will furnish the unit with or without self-contained or separate hydraulic power system. Such items as pumps, accumulators, valves, intensifiers, shock-absorbers, and accessories can be included or omitted, according to your specifications.

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color and visibility
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there is no container
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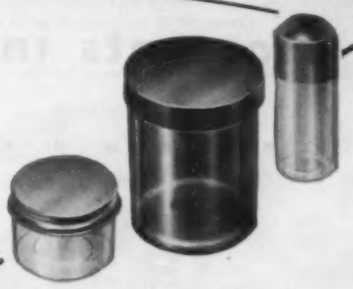

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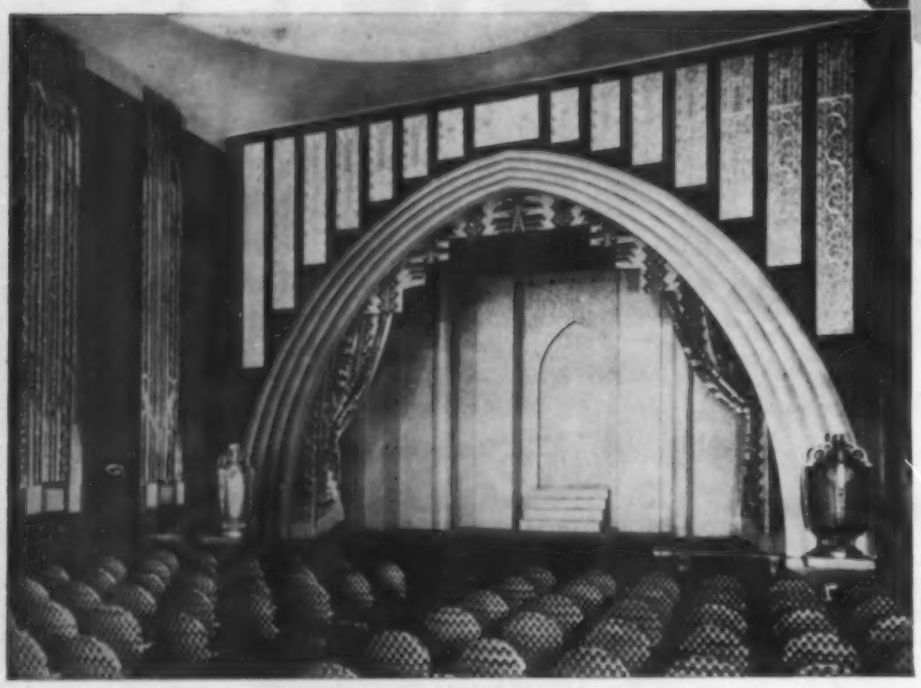

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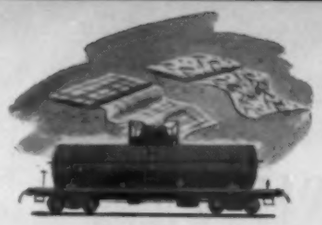
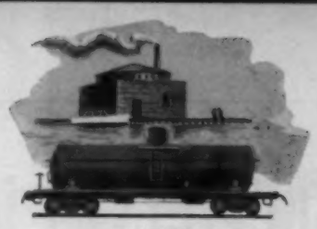
Clean, steel car, 6,000 to 10,000 gallon capacity.



CAUSTIC SODA

Heavily insulated steel car, with or without heater coils, 8,000 or 10,000 gallon capacity. Usually specially lined.



CHLORINE

Insulated, welded car; built to withstand pressure up to 500 pounds; 15 or 30 ton capacity.

COTTONSEED OIL

Clean, steam coiled car of 8,000 gallon capacity.

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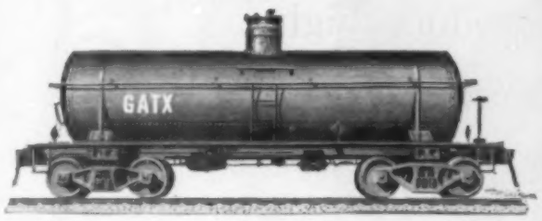

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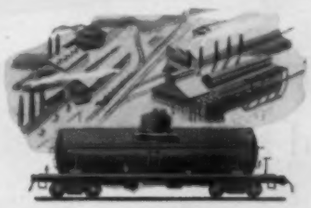
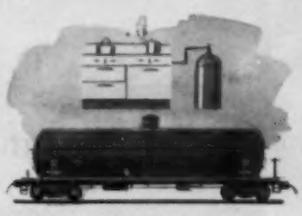


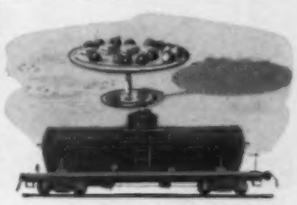
FUEL OIL

Steel car, steam coiled, 8,000 to 12,500 gallon capacity



PROPANE

Heavily constructed car, welded and insulated. Built to withstand internal pressures to 300 pounds. Capacity 10,000 to 11,000 gallons.



CORN SYRUP UNMIXED

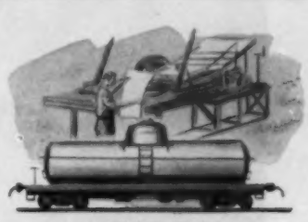
Clean, steam coiled with heavy truck capacity. Usually lined with aluminum paint.

LUBRICATING OIL

Steel car, with steam coils, single or multiple compartment; usually 8,000 gallon capacity.

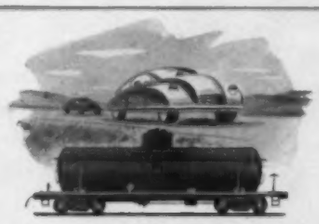
MURIATIC ACID

Car lined with pure or synthetic rubber; 8,000 to 10,000 gallon capacity.



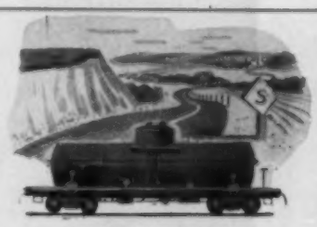
ACETIC ACID

Aluminum Car, 8,000 or 10,000 gallon capacity.



GASOLINE

Clean car, 6,000 to 12,500 gallons; single or multiple compartment.



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Heavily steam coiled car; with 2 or more inches of insulation; steam jacketed outlet; 8,000 to 10,000 gallon capacity.

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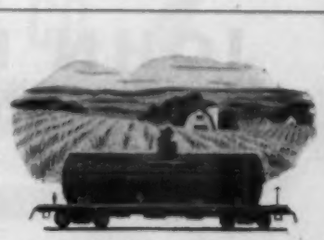
Clean steam coiled car, usually of 8,000 gallon capacity.

WINE

Insulated car with one to six compartments. Interior coated to preserve quality.

MOLASSES

Steam coiled car with heavy capacity trucks; 8,000 gallon capacity.



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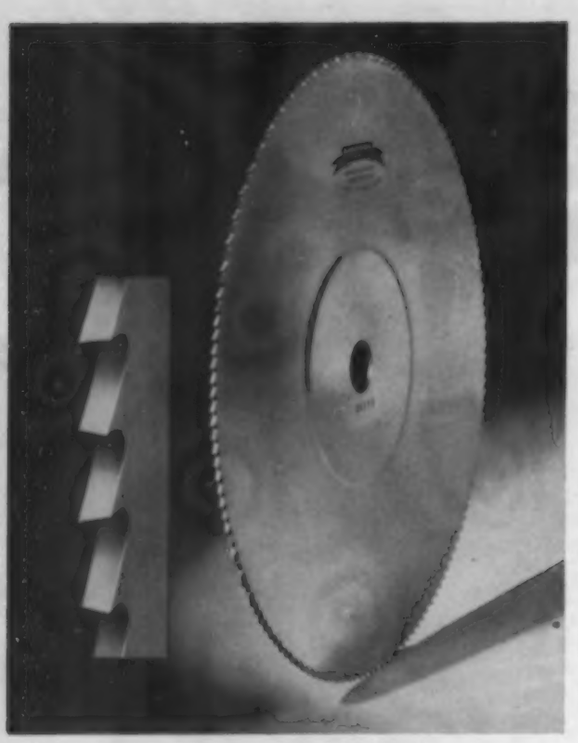

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Cut Plastics More Smoothly . . . Stay Sharp Longer Under High Heat

You're looking at one of the most successful plastic cutting saws made . . concave-ground for ample clearance, and hardened so it can be resharpened with file or grinding wheel. It's made of Simonds special high-speed saw steel which contains extra vanadium for better cutting qualities under heat, and for longer life. There are other Simonds Circular Saws, too . . . made with tungsten carbide-tipped teeth, made of semi-high-speed steel, special alloy steel, and Simonds T-11 "self-lubricating" Steel. Also, there are:

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Also — Hubs, dies, pantograph engraving, glass stone dies, glass stone molds.

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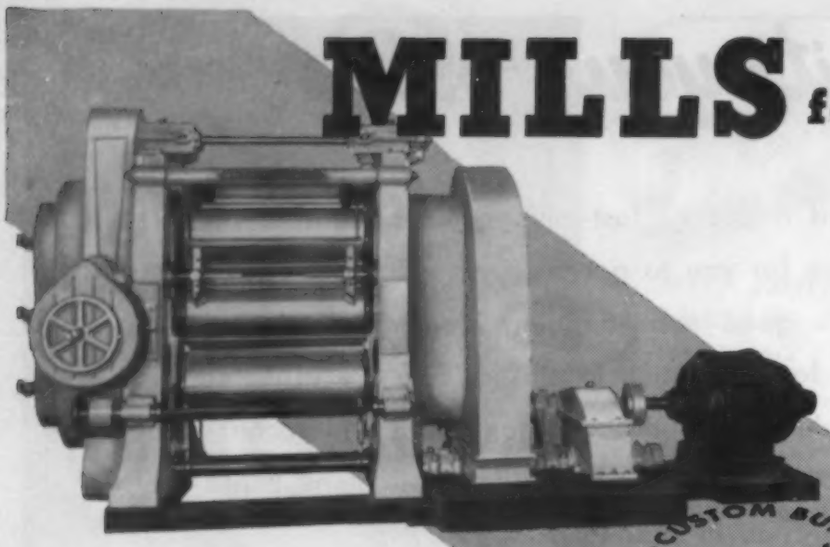
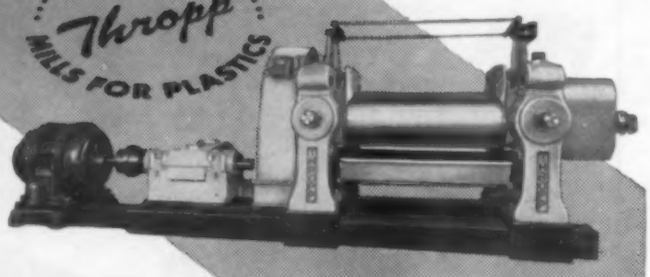
MILLS for Plastics



These new, heavy duty, three roll Calenders and 22" & 22" x 60" High Speed Mills, are just two of the many new Thropp precision built machines especially designed for plastics. They are available in all sizes for production and laboratory use. All machines are custom built and designed to meet customers' special requirements.

...CUSTOM BUILT... Thropp MILLS FOR PLASTICS



ANTI-FRICTION BEARINGS

For plastic manufacturers whose mill and calender requirements include high temperature and a precision product, we have developed a complete line of mills and calenders incorporating Anti-Friction Bearings.

These bearings are designed to provide the finest precision service available, as well as provide a bearing with circulating lubrication that does not leak.

The leakage encountered in standard oil seals has long been a source of trouble and expense to the plastic industry. It is our belief that the use of Anti-Friction Bearings with a new design oil seal will completely eliminate these difficulties.

WM. R. THROPP & SONS CO., Trenton, New Jersey

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Illustrated are a few samples of the various items we fabricate: furniture knobs, handles for houseware, spools for industrial coils, push buttons for elevator control panels.

We work to blueprint specifications.

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UNIQUE designs and shapes . . . stain resistant cavities . . . thin sections and protruding points expensive or impossible to hob . . can be made *now* by

POWDER METALLURGY

Merriman offers you a complete service on injection or compression molding cavities at savings of up to 50%. Where machining is necessary, you can cut costs sharply with Merriman high-quality powdered metal cavities!

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Our plant is modern in equipment for producing the best in molds. Compression, Injection, Transfer.

Now equipped with an eight-ounce injection machine for testing molds!

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NEW HERMES, INC.

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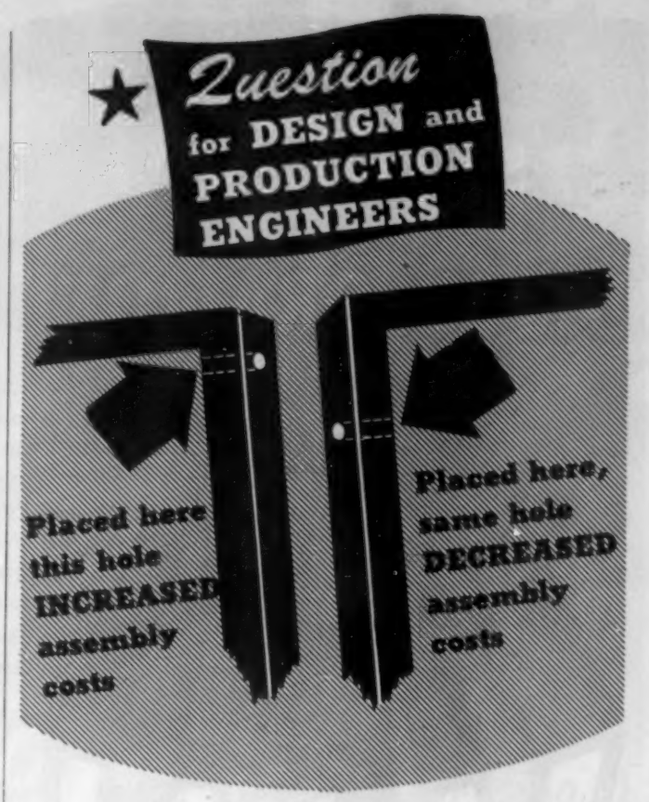
Several choice territories still open for representatives



What have assembly costs and to do with size or location of holes for fastenings?

MILFORD FASTENING EQUIPMENT

The connection is as close as the fingers of your hand. A fraction of an inch one way in the size or location of a hole — and *standard* Milford fastening equipment can be used: *thousands of dollars added to profit.* A fraction of an inch the other way — and *special* Milford fastening equipment must be used: *thousands of dollars added to cost.*

To see how an assembly that apparently requires special Milford fastening equipment could be done faster and at lower cost with standard equipment comes from knowing all the mechanical possibilities of fastenings with rivets and rivet-setting machines.

Milford engineers will gladly share their vast knowledge of the intricate field of fastenings so that wherever possible standard equipment may be used. (It's simply good business to keep customers' costs down.)

Even before a design reaches the drawing board, explore fastening methods with a Milford engineer. Consultation is in strictest confidence and without obligation.

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It's simply a matter of addition:

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+ SOUND ENGINEERING
+ 28 YEARS PRACTICAL EXPERIENCE
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We are familiar with all the latest methods of plastic fabrication and their mold requirements. Consult us for estimates on molds or problems concerning their design.

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Hope Institute

First model hospital for care of advanced cancer patients

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The EEMCO Laboratory Mill is entirely enclosed, ready to operate. It is equipped with built-in motor, control and variable speed drive. Mechanism readily accessible.

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Plastics turned into Metals

Plastics made to look like metal! That's the striking effect you get from our unique finishing process which turns plastics into glittering metal. Stunning costume jewelry and buttons made of various types of plastics can be finished to look like gold or silver. This extraordinary simulation of precious metals and special antique two-toned effects can be applied to most types of plastics—giving unusual visual qualities and beauty to molded pieces.

* Patented Process.

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Company

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Phone—WA 9-3030

BALL & JEWELL MACHINE

"the only type of Grinder ever used"

by EMELOID COMPANY

"The Ball & Jewell machine is the only type of grinding machine we have ever had, and it is doing a fine job. We feel that two machines are better than one because we can grind two colors at one time."

This statement was made by the Emeloid Company of Arlington, N. J., where they use two Ball & Jewell machines ½ to perform important scrap grinding functions. Operator is shown putting scrap into machine. Note enclosed Tex-rope drive and special baffled hopper to prevent accidents.

Leading molders, extruders and raw material manufacturers throughout the plastics industry use Ball & Jewell scrap grinders exclusively. They are invaluable in re-grinding thermoplastic scrap into re-usable molding powders of any desired granulation, and their efficiency enables them to pay for themselves in a short time. Special features include extra heavy castings, solid tool steel knives, outboard sealed S. K. F. ball bearings. The entire machine is simple in design to allow for quick takedown and cleaning when different colors or different types of materials are run.

This is # 24 in a series of advertisements showing typical Ball & Jewell installations in molding, extruding and material manufacturing plants.

BALL *and* JEWELL

20 Franklin Street, BROOKLYN, N. Y.

Since 1895, Manufacturers of Patent Rotary Cutters

CHICAGO: Neff, Kohlbusch & Bissell. DALLAS, TEXAS: Perry Machinery Co. DETROIT: J. C. Austerberry's Sons. LOS ANGELES: Moore Machinery Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ATLANTA, GA.: George L. Berry. ST. LOUIS: Larrimore Sales Co. CINCINNATI, OHIO: The Index Machinery Corp. CLEVELAND, OHIO: L. F. Willmott, 3701 Latimore Rd. SEATTLE 4, WASHINGTON: Olympic Supply Co. KANSAS CITY KANS.: Fluid Air Engineering Co. MINNEAPOLIS 20, MINN.: Chas. W. Stone. AUSTRALIA and NEW ZEALAND: Malcolm A. MacGregor, Ltd., SYDNEY. NEW YORK 16, N. Y., Foreign Distributors: Omni Products Corp., 40 East 34th St. STOCKHOLM, SWEDEN: Ingeniorsfirman Teknove. CANADA: Williams & Wilson, Ltd., Toronto & Montreal. HAWAIIAN ISLANDS: Hawaiian Sales Service, P.O. Box 3498, Honolulu 11, T. H.

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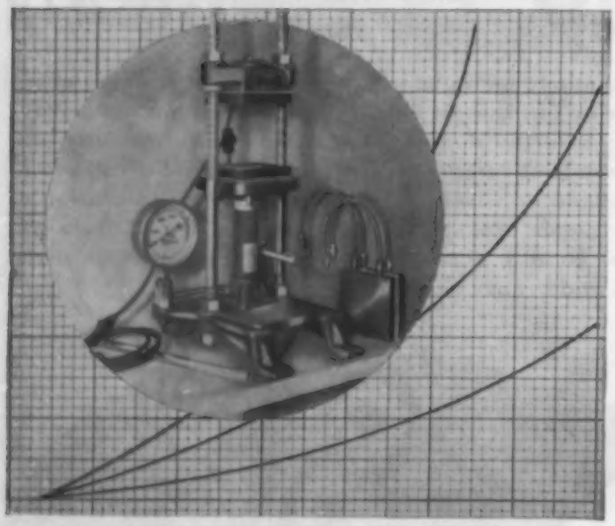

Known throughout the Plastics Industry by its Characteristic Design

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HYDRAULIC EQUIPMENT
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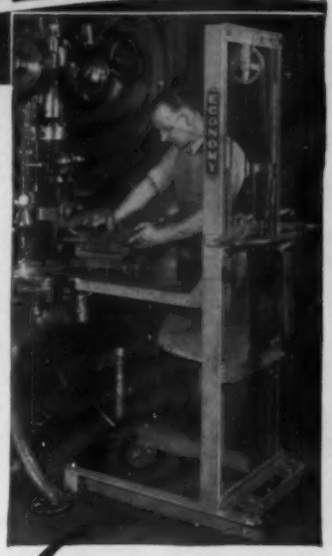
MODERN FRENCH OIL
Presses for Molding Modern Plastics

● For accuracy, speed and economical operation that brings increased profits turn to French Oil Hydraulic Presses, the choice of leading plastic molders. Complete self-contained presses with automatic time control that is instantly adjustable. Dependable, modern French Oil presses in sizes up to 1500 tons are the choice of leading plastic molders. Consult French Oil engineers or write for catalog.

THE FRENCH OIL MILL MACHINERY CO.
(HYDRAULIC PRESS DIVISION)
PIQUA OHIO U.S.A.

Save production time with a

SHOPLIFTER



One man can handle heavy dies up to 500 lbs. alone.

•

Handy for general shop lifting jobs—loading trucks, etc.

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Easily moved about on the 4" diameter wheels.

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Platform, steel plate, 24"x24"
Overall height—6'0"
Platform lift—4'6"

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Floor lock (optional) holds machine firmly to the floor.

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Other Economy Lifting Machines of heavier capacities up to 5000 lbs. available.
Write for catalog.

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PROMPT DELIVERY

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Price $157.50
Floor lock $10.00 extra.
Full Freight Allowed

ECONOMY ENGINEERING CO.

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MANUFACTURERS & FABRICATORS

NOW! SPECIAL . . . .

3/16" LUCITE AVAILABLE THICKNESS
FOR IMMEDIATE DELIVERY!

The famous HOUSE OF PLASTICS are distributors of only the finest Grade-A plastics . . . and supply America's leading manufacturers and fabricators with complete lines of all types.

PLEXIGLAS
Rectangular shapes—varied sizes

PLEXIGLAS RODS
1/8 to 1"

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FOR PRICE AND QUANTITY LISTS

HOUSE OF PLASTICS — HP — SERVICE

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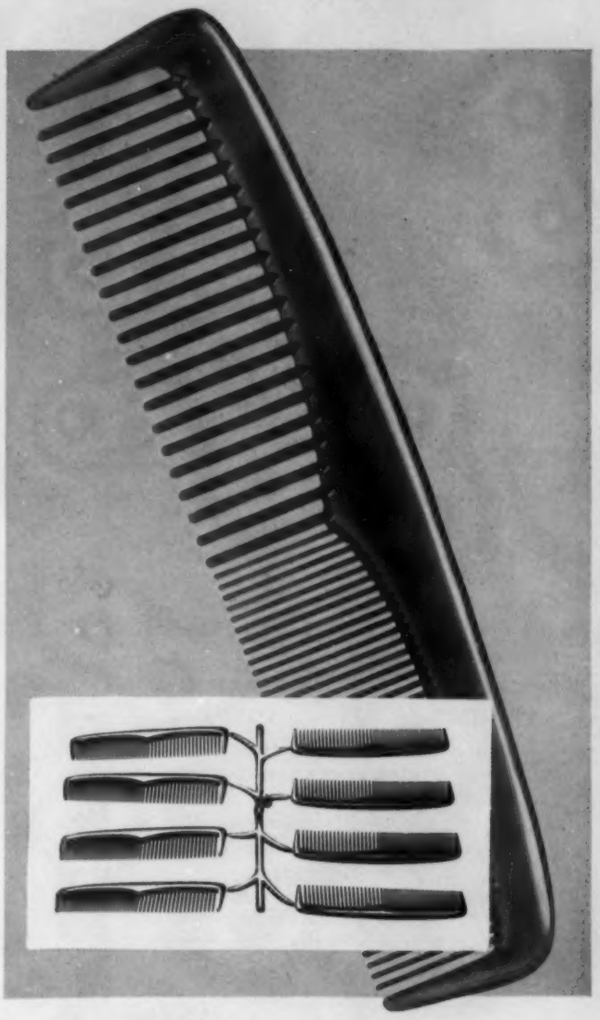
COMPLETE MOLDS

for injection and compression molding



Polystyrene comb molded with 8-cavity injection mold by Sossner

SERVING THE PLASTICS INDUSTRY

We specialize exclusively in molds, hobs, hobbed cavities, and steel stamps. Send us your most intricate designs, your toughest mold making problems. Your design or blueprint will be reproduced to the finest precision details.

TAPS • HOBS • DIES • STAMPS *FOR PLASTICS*

SOSSNER

161 GRAND STREET, NEW YORK 13

FROM BLUEPRINT TO PRODUCT IN PLASTICS BY FELSENTHAL . . . FROM BLUEPRINT TO PRODUCT IN PLASTICS BY FELSENTHAL . . . FROM BLUEPRINT TO PRODUCT IN PLASTICS BY FELSENTHAL . . .

'Felsy' the Plastic Perfectionist

RINGS THE BELL FOR ASSEMBLY

"Yes sir," says Felsy, who holds his Degree from the School of Experience, "I can really ring the bell on big and complicated assembly jobs. . . . The kind that involve a lot of operations, a lot of parts, a lot of processes, a lot of work."

Correct! In addition to the experience and the manpower, we have a complete set-up for

SCREENING ENGRAVING
PRINTING FORMING
HEAT SEALING and
DOZENS OF OTHER FABRICATING OPERATIONS

All in one plant—all under one roof—all under one responsible management.

Write for booklet 3-A on your letterhead. It illustrates scores of parts and products made to blueprint specification by Injection Molding, Laminating, and Fabricating.

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BRANCH OFFICES: NEW YORK • DETROIT
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- America's leading plastics designers and engineers will be there!
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EXHIBITORS!

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Special Organic Peroxides

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TRADE MARK

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NOVADEL-AGENE CORPORATION
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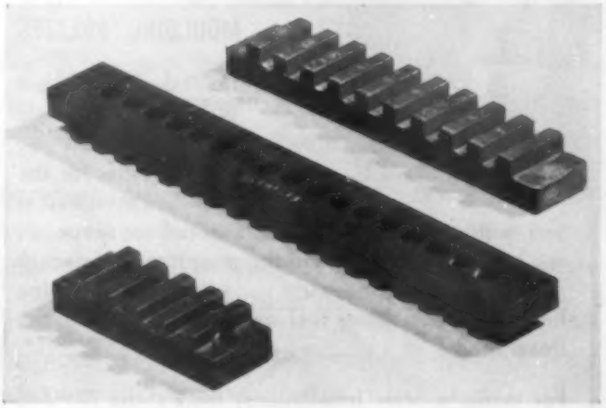
SKILLED AND TOOLED FOR PRECISION MOLDING

Terminal Strips...



Custom Molded Plastics engineered by Midwest, consistently measure up to exacting specifications and requirements. Address your inquiries to MMM, confident that you are consulting an organization skilled and experienced in precision techniques for the production of plastics.

Midwest Molding
AND MANUFACTURING COMPANY
331 NORTH WHIPPLE STREET · CHICAGO 12

One thumb to a hand

is enough!

A WORK-GLOVE that makes every finger a thumb, makes mockery out of safety! For safety starts with a sure, firm grip . . . a flexibility that allows quick, certain use of the hands in every situation. That's why workers in the plastic industry *like* JOMAC Industrial Gloves. These remarkable gloves make for flexibility right down to the finger-tips!

What's more, JOMAC Industrial Gloves give longer-wearing protection against hand-hazards of every kind . . . biting edges, rough surfaces, blistering heat. There is a scientific reason for this better protection, for the *longer life* you find in JOMAC Industrial Gloves. JOMAC's famous fabric is composed of hundreds of "cushions" . . . protective "air-cells" locked securely into place by a hidden stitch.

Yes, JOMAC Industrial Gloves give *longer life* . . . up to 7 *times* the wear of ordinary work-gloves! Washable, they can be laundered repeatedly and used over and over again. That's glove-economy in anybody's language! For full details, write today to C. Walker Jones Co., 6135 N. Lambert St., Philadelphia 38, Pa. Plants in Philadelphia, Pa., Detroit, Mich., and Warsaw, Ind. *Foreign Representatives:* Gillespie & Co. of New York, Inc., 96 Wall Street, New York 5, N. Y.

"SHAKE HANDS WITH SAFETY"

JOMAC INDUSTRIAL GLOVES

THREE TYPES OF JOMAC GLOVES

REGULAR INDUSTRIAL TYPE • HEAT- AND FLAME-RESISTING
SAFETY GAUNTLET-CUFFS

THERE ARE TWO SIDES TO EVERY STORY

YOU may be a plastic buyer who is looking for the best in such stock items as picture frames, door plates, drawer pulls or cable clamps

OR you may be a manufacturer who is looking for a reliable, complete custom-molding service

IN EITHER CASE, the record of Continental Plastics Corporation insures the finest in precision craftsmanship, originality and economy.

Send or bring in your sample product or blue prints for an honest and accurate appraisal.

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In addition, the Stock Mold Book contains a list of 200 extruded profiles of all types and a section devoted to stock laminated sheets, rods, tubes.

PRICE **$5.00** per copy
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ORDER FROM →

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TAILOR-MADE

for your

INDIVIDUAL

MOULDING PRESSES

That's the KANE Low Water Line Automatic Gas-Fired Boiler . . . built to order for the operating pressure that you require. It is compact . . . saves floor space . . . can be placed right next to the press it serves; permits gravity return of condensate . . . eliminates long pipe lines and traps; burns fuel only in proportion to the steam used.

For multiple press installations, there's the KANE Standard Boiler. Both types are built A.S.M.E. to specifications.

Although current demands cannot be supplied immediately we'll try to supply your urgent needs as soon as we can.

MEARS-KANE OFFSET

Manufacturers of Automatic Steam Boilers for over a third of a century

1903-1915 EAST HAGERT STREET, PHILADELPHIA

BLODGETT GAS-FIRED PLASTICS OVEN USED TO PRE-DRY INJECTION POWDER

Novel Products Co., Burlington, Vt., uses our No. 158 Gas-Fired Oven to pre-dry acetate granules, as the first step in their injection moulding process.

Photo shows F. W. Bailey, Manager, inspecting tray of granules about to be placed in oven.

"Blodgett's plastics ovens are extensively used in the plastics industry for every process where rapid, controlled, heat is required —preform heating, drying, thermosetting, softening of thermoplastics, fabrication of acrylic resins and many other operations."

Write today for your copy of "Blodgett Ovens for Plastics Products."

The G. S. BLODGETT CO. Inc.

50 Lakeside Ave., Burlington, Vt.

For Laminating Materials

Use **PHENOPREG**

For all jobs requiring laminating materials, reinforcing materials, molded laminated, etc., investigate PHENOPREG.

For decorative laminates, such as table tops, bar tops, wall panels, or similar requirements we recommend our PHENOPREG MB grades which include a complete range of colors and patterns.

For special coating or impregnating jobs we have the finest equipment available.

We solicit your inquiries outlining your problems or specifications.

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Plastics Division

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Molding Projects of All Types

Our staff of experienced plastics molding technicians guides your project through from the seed of an idea to the finished product.

The Steps:

- Styling and Designing
- Model Making
- Mold Building
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- Operations Controls
- Heatronics
- Molding and Finishing Problems

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AMERICAN PLASTICS ENGINEERING CORPORATION

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EGG-BEATER HANDLES MOLDED BY AUBURN FOR THE TURNER AND SEYMOUR MANUFACTURING CO.

AUBURN'S

Plastics Gallery

Auburn molded plastics have served American industry for the last 70 years. Auburn "know-how" is the product of that experience . . . it is the extra value you get when you choose Auburn as your custom molder.

MOLD AB MARK

AUBURN BUTTON WORKS, INC.

FOUNDED IN 1876 • AUBURN, NEW YORK

AUBURN ENGINEERED PLASTIC PRODUCTS

Compression, Transfer, and Injection Molding
Automatic Rotary Molding for Mass Production
Extruded Vinyl or Acetate Tubes and Shapes
Cellulose Nitrate Rods, Sheets, Molded Parts
Mold Engineering and Complete Mold Shop

LOOKING FOR STABLE

Plastic Colors?

Then you'll want to investigate *Ferro's inorganic colors*—ideally suited for compression and injection molded plastics. Select from full color range. Colors stable (to 2300 degrees Fahrenheit) and highly chemical-resistant. Write for further details and samples.

Color Division

FERRO ENAMEL CORPORATION

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Pearl Essence

Special types have been developed for use with

Cellulose Esters (Acetate, Butyrate)
Cellulose Ethers (Ethyl Cellulose)
Vinylites (All types)
Acrylates (Lucite, Plexiglas)
Polystyrenes

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THE MEARL CORPORATION

183 Waverly Place New York, N.Y.

INFRA-RED in the PLASTIC INDUSTRY

Branch of the industry	Name of Appliance	Use
Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically granule by granule
Molders (Thermo-setting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk quantities
Fabricators (Miscellaneous)	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and shapes for bending, forming, punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate and Bakelite

(The time on most of the operations mentioned above averages five minutes)

THE MISKELLA *INFRA-RED* COMPANY

DESIGNERS — MANUFACTURERS OF
INFRA-RED OVENS • APPLIANCES • SECTIONAL UNITS • MACHINES AND CONVEYORS
Main Offices and Laboratory
East 73rd and Grand Ave., Cleveland 4, Ohio

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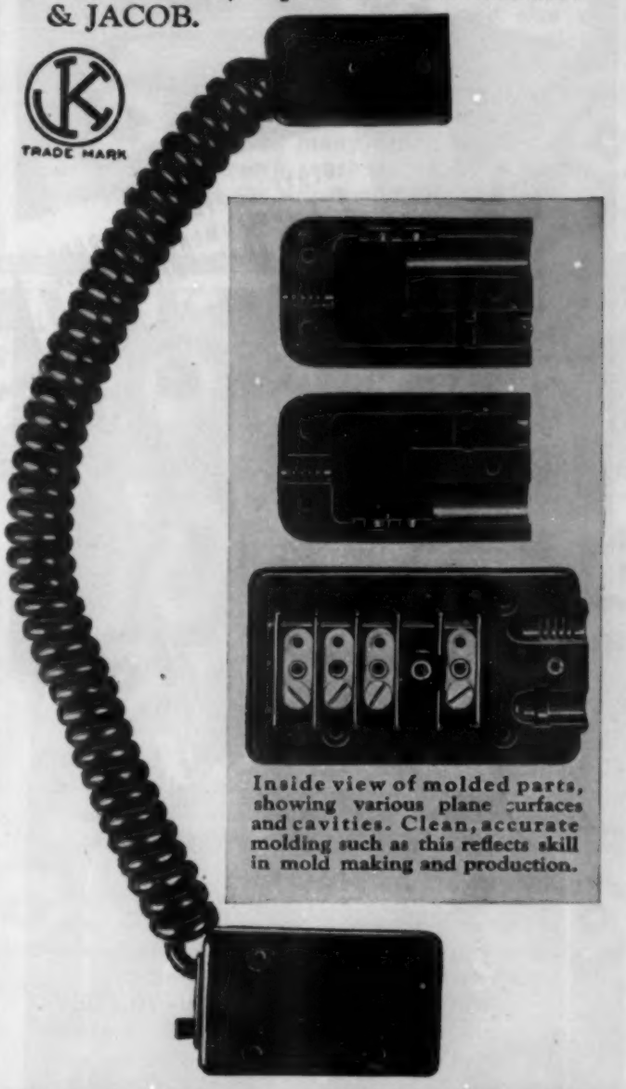
for details write to
NATIONAL TRANSPARENT PLASTICS COMPANY
SPRINGFIELD MASSACHUSETTS

Plastic Molding THAT SAVES LIVES

Yes, just that! The accuracy with which the earphones of this Aviator's Microphone Head-set is molded is what helps to make it possible for the pilot to bring the great ship home "on the beam". Such accuracy is paramount at KUHN & JACOB.



TRADE MARK

Inside view of molded parts, showing various plane surfaces and cavities. Clean, accurate molding such as this reflects skill in mold making and production.

KUHN & JACOB
MOLDING & TOOL CO.
1200 SOUTHARD STREET, TRENTON, N. J.
TELEPHONE - TRENTON 5391

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S. C. ULLMAN, 55 W. 42ND ST., NEW YORK, N. Y.
TELEPHONE - PENN 3-0346

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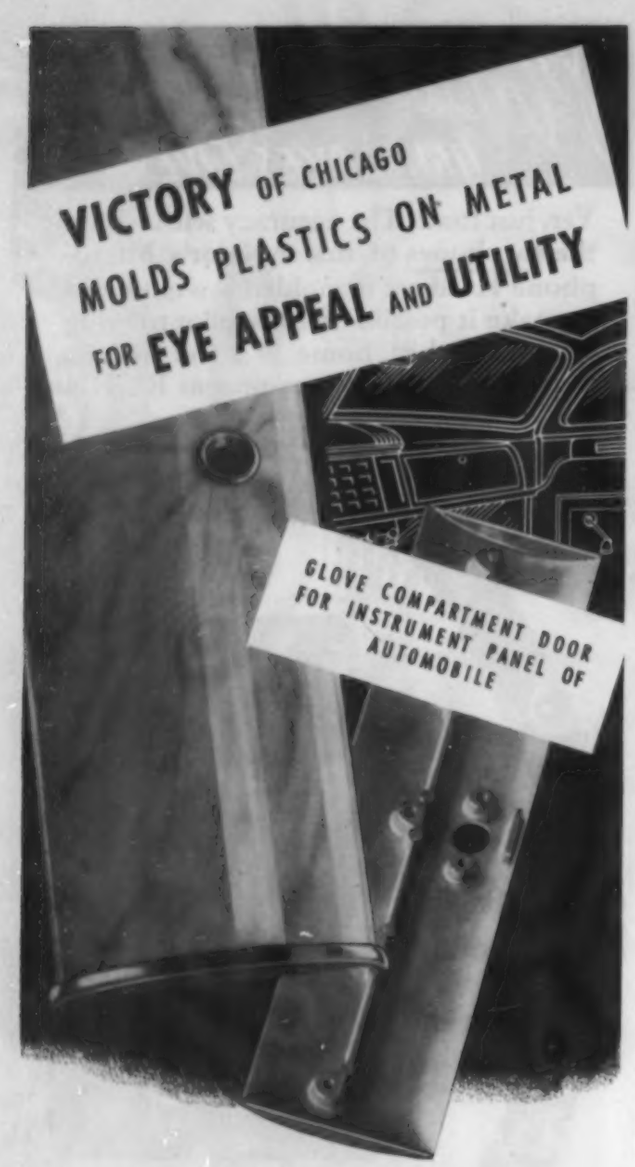

When a leading automobile maker required both beauty of finish and intricate die-cast insert molding VICTORY met the need, as you will recognize in the current cars.

VICTORY also has the experience, skills and equipment to produce plastic moldings with screw machine inserts and large metal stamping inserts with precision accuracy and mass economy.

Whatever your plastic problem, VICTORY Engineers, Designers, Mold Makers, Molders and Assemblers will help you solve it. Send us your specifications for our estimate.

Up to 17 oz. Shots
Automatic Injection Molding.
ALL THERMOPLASTIC MATERIALS
Specializing in *large parts.*

VICTORY of CHICAGO

MEMBER: The Society of The Plastic Industry

VICTORY MANUFACTURING COMPANY
1724 W. Arcade Place, Chicago 12, Ill.
ESTABLISHED IN 1935

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Unexcelled in purity and uniformity, SOLKA-FLOC is produced in a wide variety of physical forms giving unusual combinations of technical properties. Members of the line are unique in the filler field, being excellent binders from non-abrasive organic origin, low in specific gravity and of negligible ash content. The color range of SOLKA-FLOC is from natural cream to pure white. A variety of fibre lengths is available; bulk, apparent density, and absorbency can be controlled. This rare combination of properties has proved its merit in commercial application and SOLKA-FLOC is being profitably adapted to use in the following fields; rubber, plastics, adhesives, protective coatings, ink, filtration, plastic wood, decorative coatings, cosmetics, etc.

For details on how SOLKA-FLOC may be employed to extend supplies of more critical materials, produce new or better finished products, or facilitate manufacturing operations, address our Technical Service Department. Full help will be granted gladly, regardless of your operations, and adequate samples of SOLKA-FLOC supplied.

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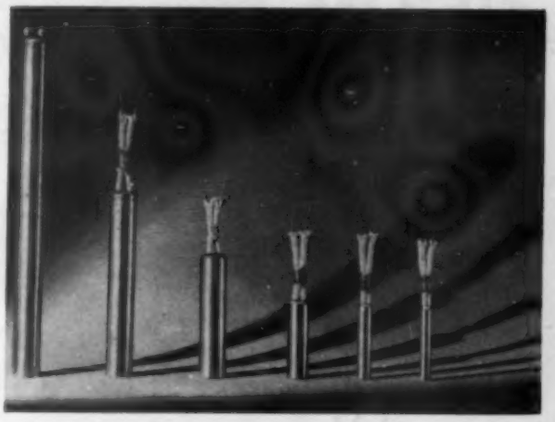

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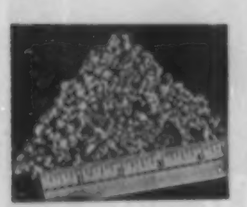

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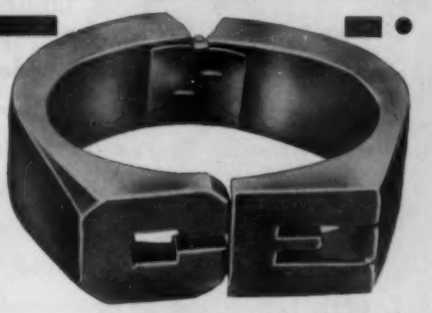

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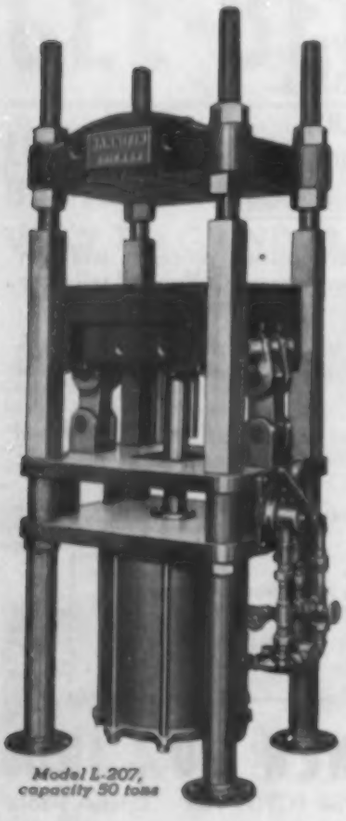

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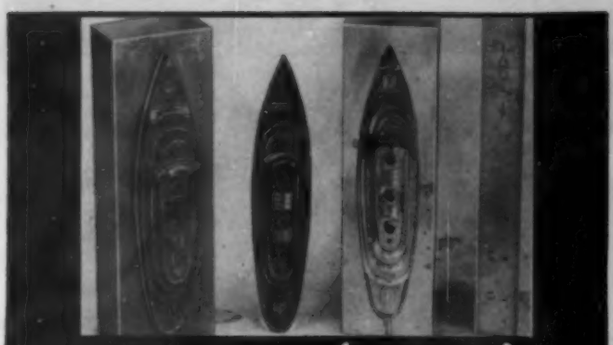

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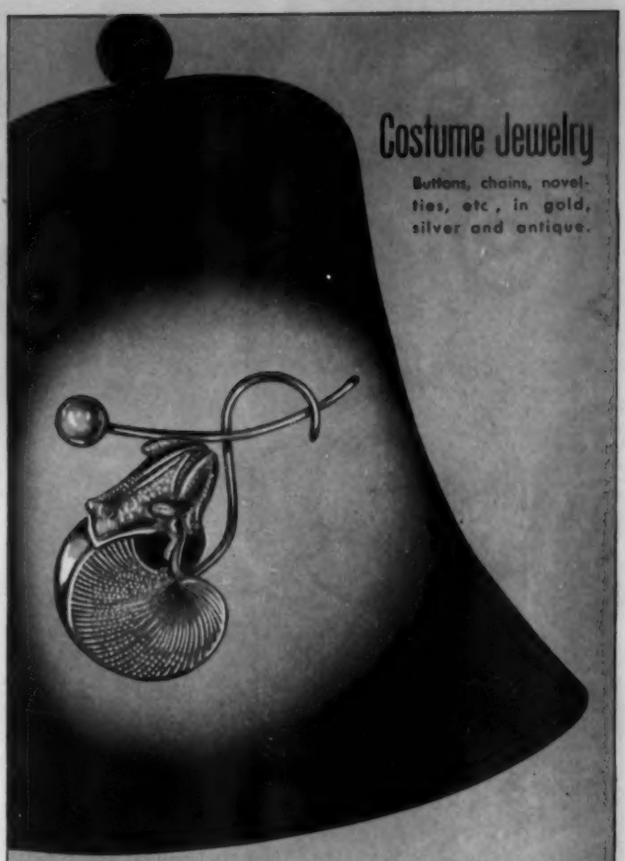

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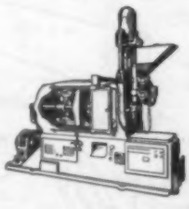

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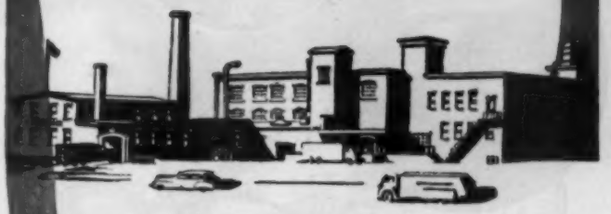

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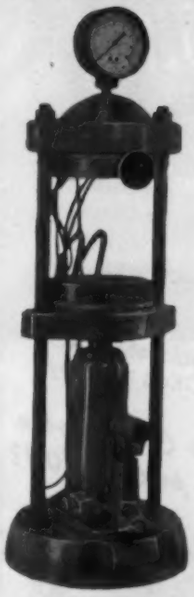

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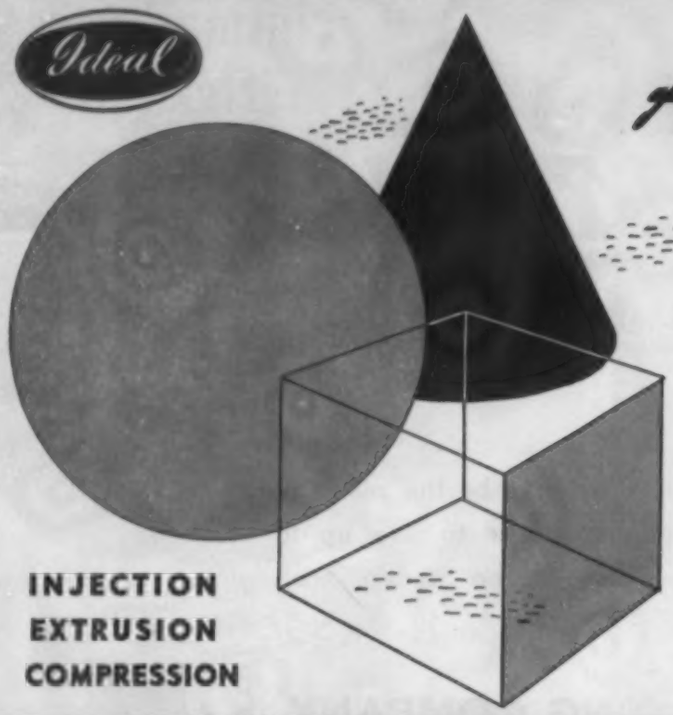

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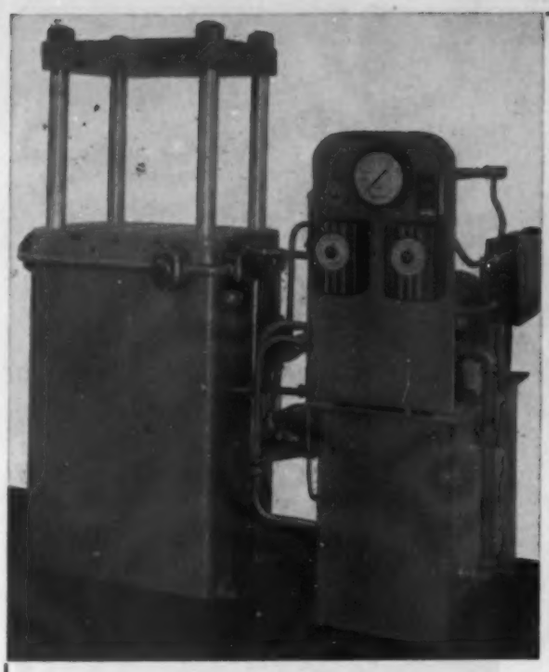

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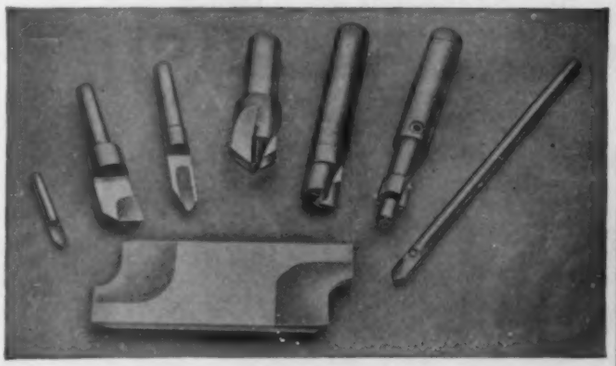

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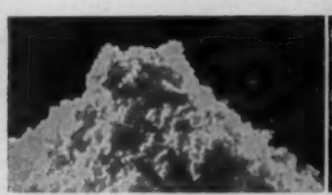

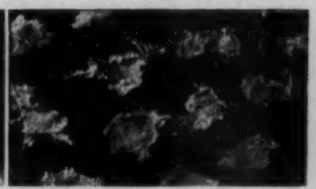

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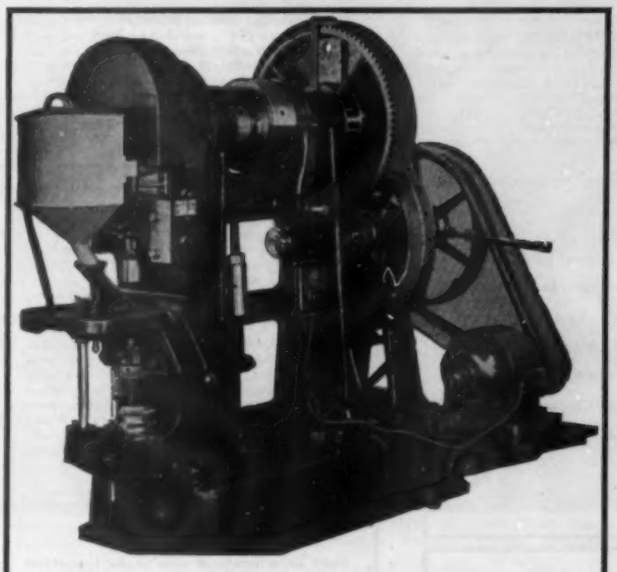

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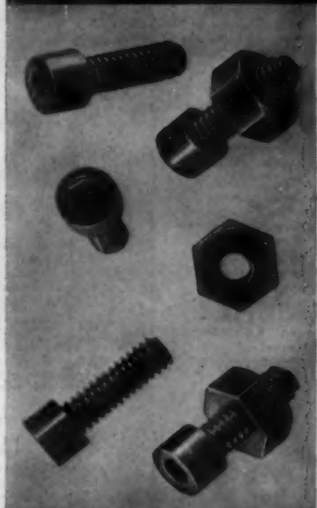

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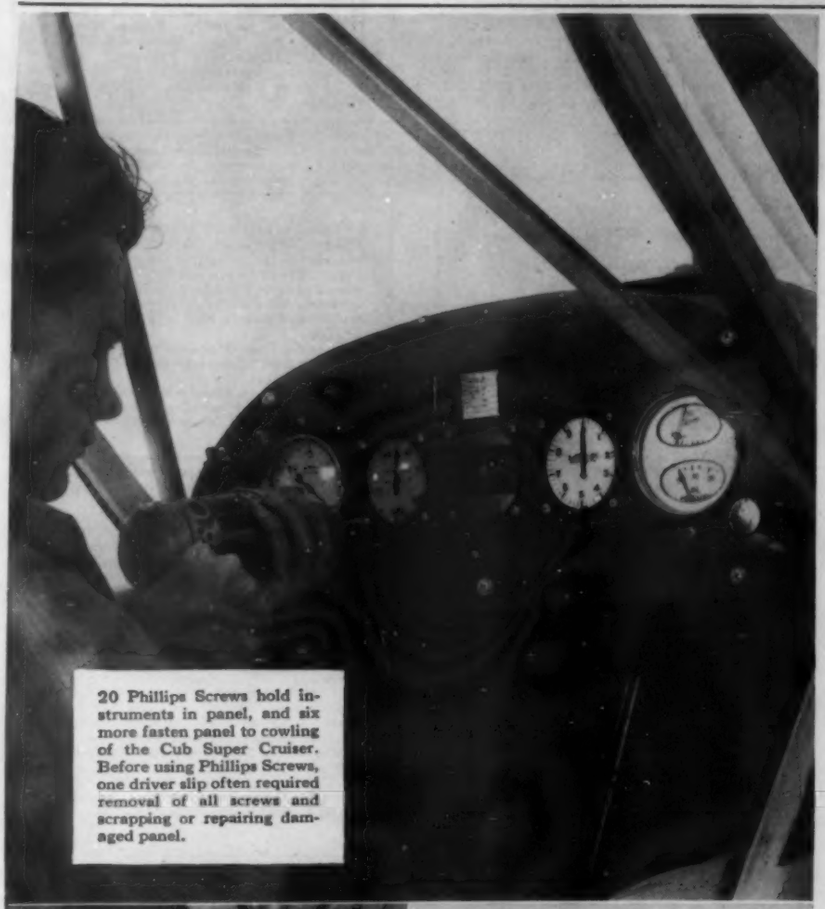

20 Phillips Screws hold instruments in panel, and six more fasten panel to cowling of the Cub Super Cruiser. Before using Phillips Screws, one driver slip often required removal of all screws and scrapping or repairing damaged panel.

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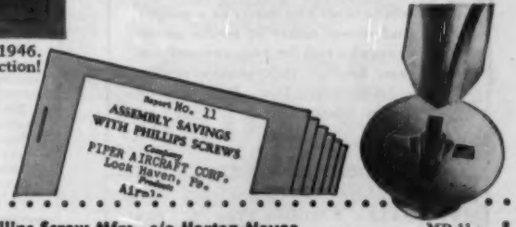

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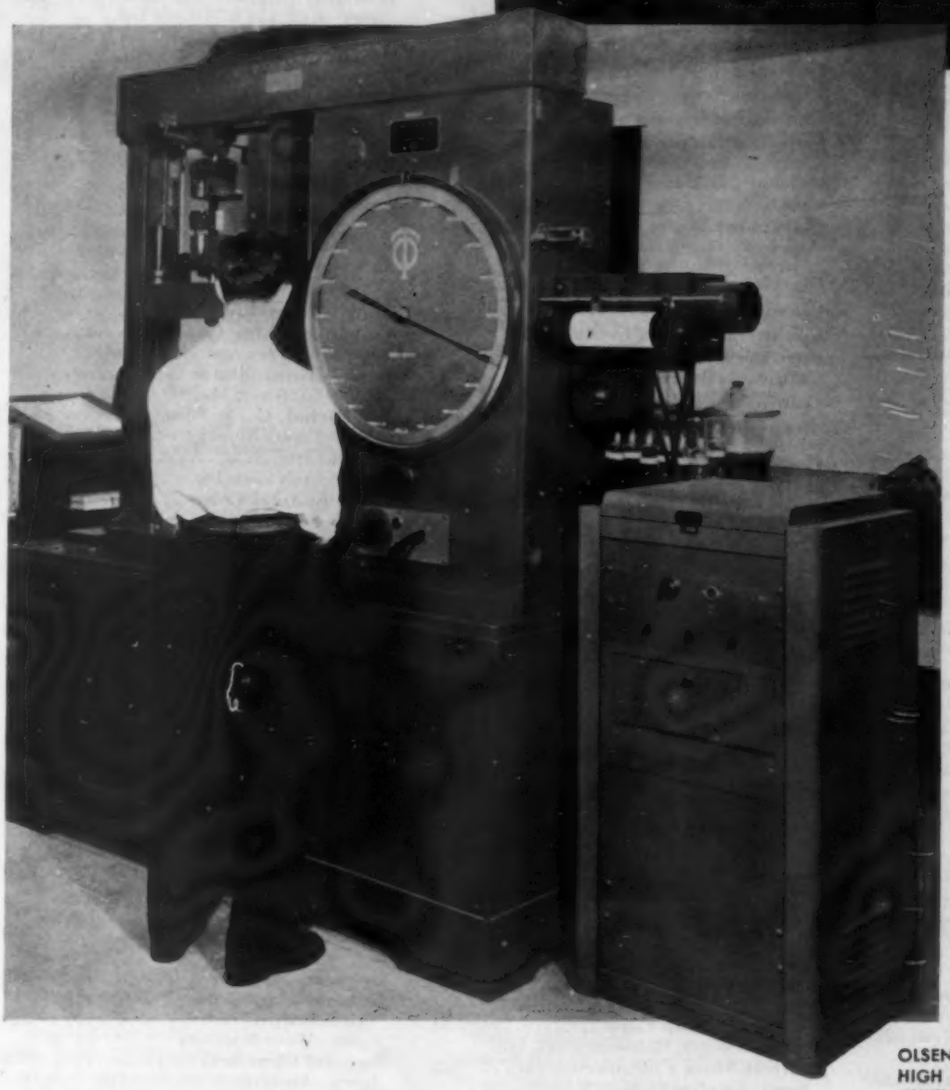

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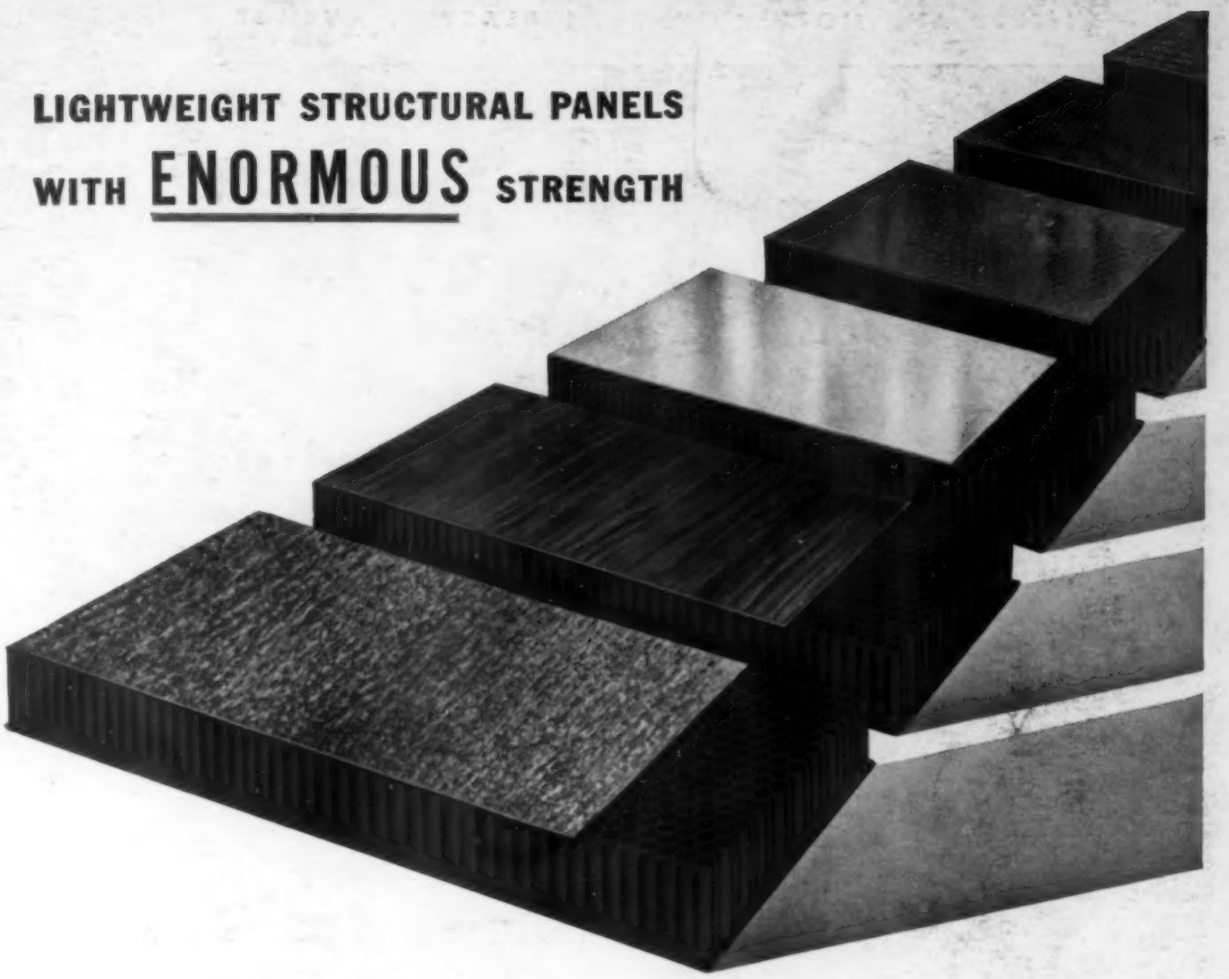

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